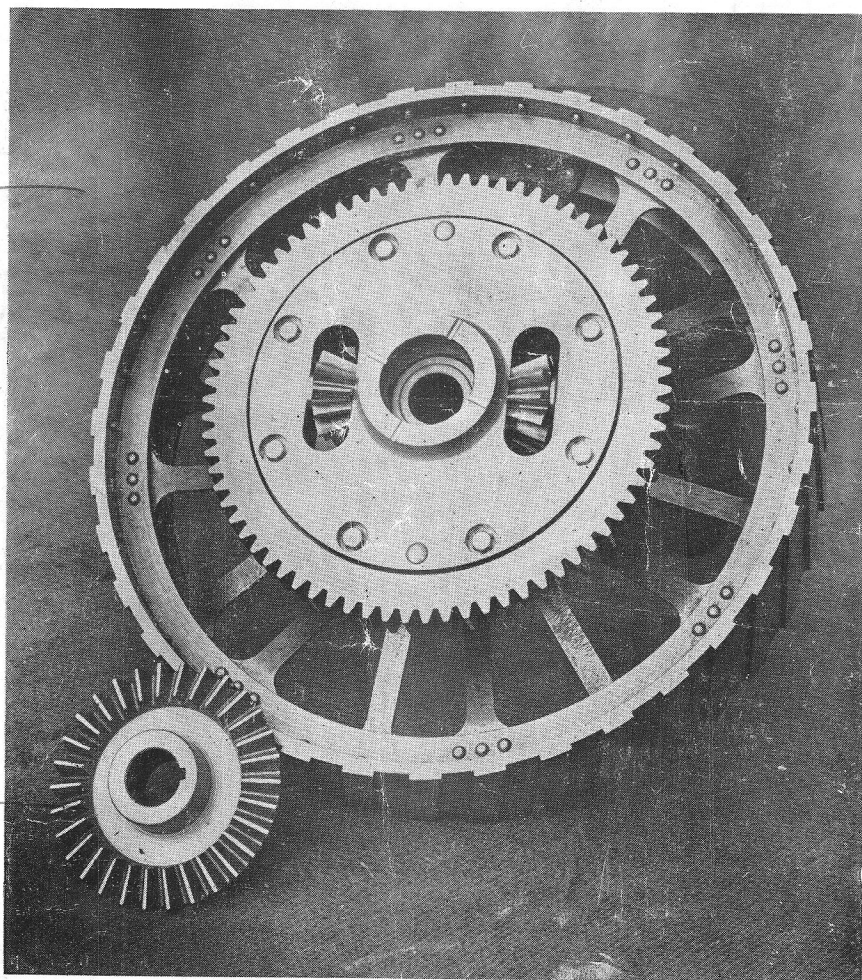


THE MODEL ENGINEER

Vol. 95 No. 2381 THURSDAY DECEMBER 26 1946 6d



"Wheels within Wheels" !

Another interesting photograph from Mr. J. Hellewell, of Luton. On our cover for December 5th, last, was seen the set-up for roughing-out the differential bevel for a 1-in. scale "M.E." Traction Engine; above we see the rear wheel with the differential assembled on it.

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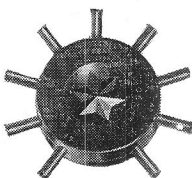
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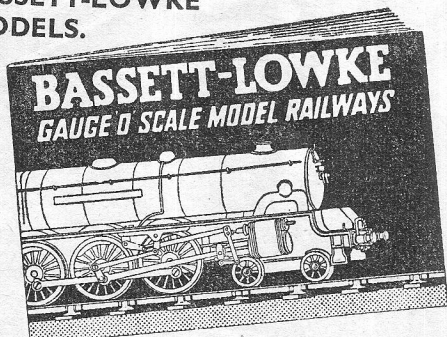
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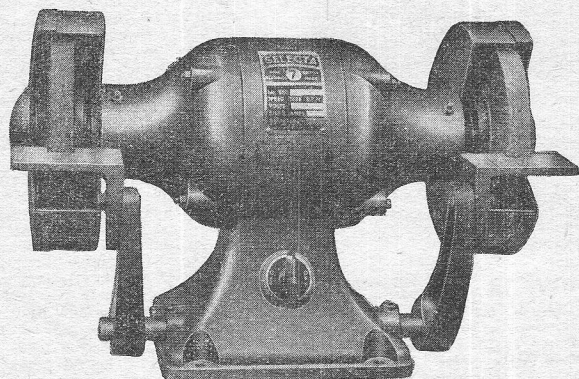
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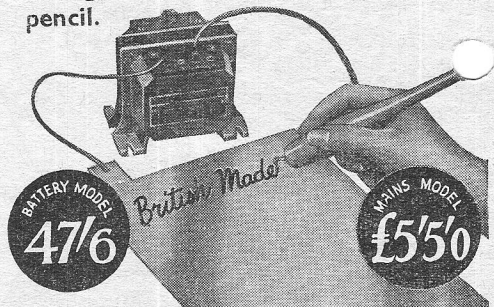
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THE MODEL ENGINEER

Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2

VOL. 95. No. 2381

DECEMBER 26th, 1946

To Remind You

JUST a line to remind you that when you call on your newsagent for **THE MODEL ENGINEER** next Thursday he will ask you for 9d. instead of 6d. I hope you will pay up with a smile, for you will bring away a better **MODEL ENGINEER** than you have ever had before. Run your 12-in. rule over it and measure up the value it contains. As an expert model engineer, how much an hour would you ask if you had to write and illustrate all the practical articles it offers. Tot up your wage-pocket at the end of the job; it would make that 9d. look very small, wouldn't it? There is plenty of good material awaiting you, and week by week **THE MODEL ENGINEER** will get better and better. It is our job to produce it, but we want your co-operation. We want to know what subjects interest you most. We need photographs of your workshops and your models, your items of news, your practical hints and tips, your letters for our correspondence columns, and, if you must, your complaints and grumbles. We want you to have a share in making **THE MODEL ENGINEER** your paper in the fullest possible sense, so that more than ever you will be a real member of the family. In fact, we want you to feel when you get your copy from your newsagent "this is my paper." If we all pull together we can make it so; let us be proud of it. **THE MODEL ENGINEER** must always be the open door to the finest practical hobby and the happiest brotherhood of enthusiasts in the world. That's a New Year resolution both for you and for me.

Shipwrights Exhibition

THE Worshipful Company of Shipwrights, of which His Majesty the King is permanent Master, is one of the oldest of the City Livery Companies, its history dating back for 700 years. This exhibition is the first of its kind to be held for 70 years, and has been organised to show the British public what the shipping and shipbuilding industries of this country have achieved in the past, and also what

is being done today. It is, in short, both historical and educational. There are hundreds of fine models of ships, machinery and auxiliary equipment. Some of the models are of ships, both naval and merchant, which did some very fine work during the recent world war. There will be one special section, where young men inter-

ested in following the sea, whether in operating ships or building ships, can obtain advice on how to achieve their ambition. The exhibition will be held at the Royal Horticultural Society Halls, Westminster, London, S.W.1, January 28th to February 8th, 1947, excepting Sunday, February 2nd, and will be open from 10 a.m. till 9.30 p.m. each day. Full particulars are obtainable from the Exhibition Committee, Worshipful Company of Shipwrights, 3, Lloyd's

SMOKE RINGS



Avenue, London, E.C.3.

Business Hours

A COMPLAINT has reached me from a London reader that on two occasions he has at some personal inconvenience endeavoured to make an urgent purchase at a model supply stores professing to remain open for business till 5 o'clock. At his first visit he found the shop closed at 4.55, and a friend acting for him had the door shut in his face at 4.50. Many model engineers are restricted in their movements by their own business responsibilities and cannot shop when and where they like. It is therefore very annoying when they conform to the stated hours of a supply firm only to find that they are frustrated by a staff whose mind is too fully occupied with thoughts of early closing. A later closing hour on one day a week might be a real blessing to many would-be customers.

Percival Marshall

H.M.S. "AJAX"

A 28-in. Electrically-
driven Model

By N. Spackman
(Canada)

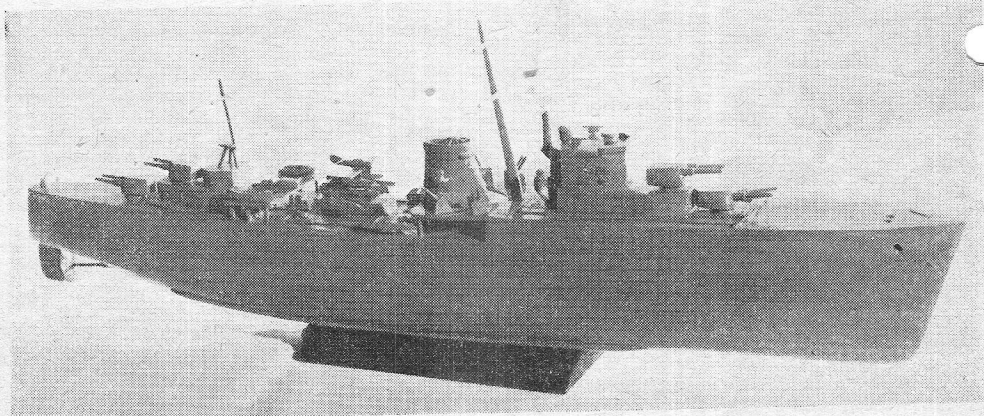


THE model about to be described has had a rather chequered career. Started originally in Camp Shilo, Manitoba, late in 1942, construction was suspended until the fall of 1945, while the writer was overseas. Work was resumed in the fall of 1945, and was carried on in camps as far apart as Ontario, Canada, and Oklahoma, U.S.A., the model being finally completed in Alberta, Canada.

The model is based on the excellent description and drawings by R. F. Dolphin, in the issue of THE MODEL ENGINEER for August 24th, 1939. The actual size of the model is twice that of the drawings given in THE MODEL ENGINEER, giving an overall length of 28 in. The depth was increased by $\frac{5}{8}$ in., since the original drawings were for a 5-ft. model, and it was felt that a straight reduction in dimensions would unduly reduce the displacement. As events turned out, this was a wise move; the extra buoyancy thus obtained coming in very useful.

The "bread-and-butter" system of construction was adopted, as workshop facilities were very limited. Ordinary white pine boards were used; the lifts were cut roughly to shape with a coping saw, the insides finished with pocket-knife and sandpaper, and were then glued together with casein glue. A small thumb-nail plane was made to assist in the shaping of the outside; the blade was part of a $\frac{1}{2}$ -in. \times 6-in. smooth file, softened in the forge and filed to shape, while the body was made from a scrap of oak. This proved extremely useful after the working face had been rounded off in every direction.

After experiments with several different materials, it was decided to make the superstructure of 0.030 celluloid, of the kind used for storm windows for vehicles. All the upper works were built of this material, in sections around wooden formers which were afterwards removed; this gave a light and very strong superstructure. The only awkward job was the tapered funnel

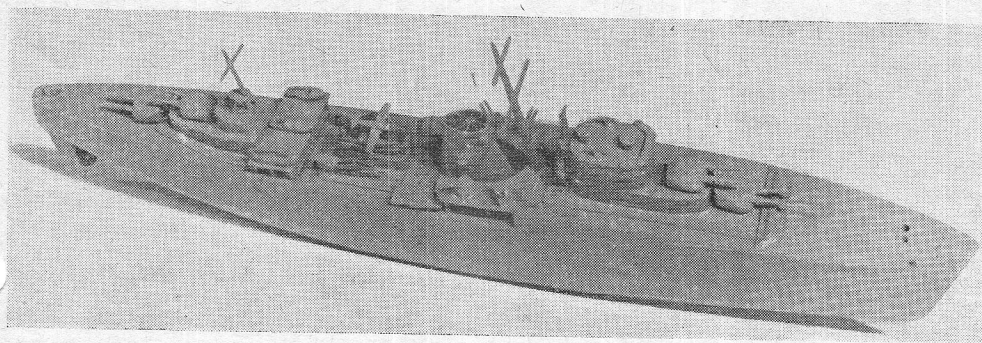


characteristic of this class; this was made in three sections which were afterwards cemented together. Guns, turrets, torpedo tubes, etc., were made of scraps of oak and maple, and the masts of bamboo.

Motive power was a problem. It had been intended originally to use a small accumulator as a source of power, but neither accumulators nor motors of the type required were available at the time. Eventually, the writer obtained a 6-volt 3-pole motor, in a considerable state of disrepair,

standard radio on-and-off switch, the stem passing up through the bridge; the control button is unobtrusive and easily reached.

A piece of hard brass is let into the stem to form a cutwater. Bilge keels are of $\frac{1}{8}$ -in. square steel. The stern tube is a piece of $\frac{3}{16}$ -in. steel gas line, the bearings being bits of brass rod driven in either end and drilled by hand. A half-round reamer was made from a piece of $\frac{1}{8}$ -in. drill rod used for the propeller shaft, and the bearings finish-reamed *in situ*. A gland was not fitted; a



which had originally done duty in a "HO"-gauge locomotive. This was overhauled and put in running order, and it was found that by using five standard flashlamp dry cells in series a satisfactory performance was obtained.

A twin-screw drive, embodying a reduction gear, was made from some small bronze pinions which came originally from some form of instrument. Spindles were $\frac{3}{32}$ -in. drill rod, running in plain holes in the $\frac{3}{32}$ -in. brass frame. After running for a while in thin machine oil mixed with the sludge from the bottom of a can of Brasso, the gear box ran very smoothly and sweetly. However, when coupled to the small locomotive motor it was found to absorb so much power that it was decided to use a single screw, direct driven through a universal joint. This system has proven very satisfactory indeed, driving the model at a good walking speed in still water. The universal joint is made of hard fibre with brass insert for the squared end of the motor spindle, the arms being drilled a clearance fit for the $\frac{1}{16}$ -in. pins on the propeller shaft.

The dry cells are housed in a tinplate tube made from a 4-lb. jam tin), with spring brass contacts at either end, so that the dry cells could be loaded as in a flashlight. The switch is a

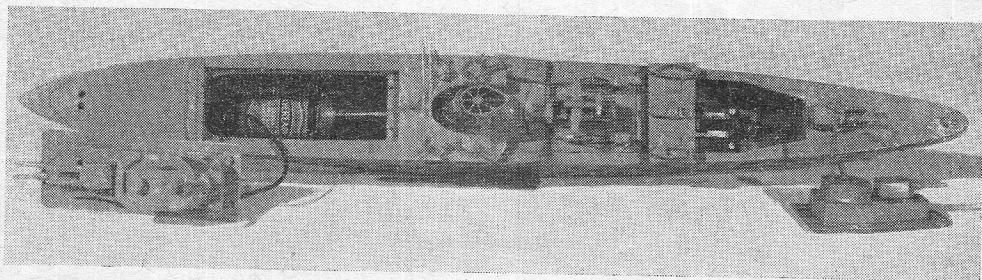
well-fitted and lubricated bearing should pass only an infinitesimal amount of leakage, and a gland can absorb a lot of power. Actually, no trouble has been experienced with leakage. The propeller is $1\frac{1}{8}$ in. diameter.

Approximately $1\frac{1}{2}$ lb. of lead was required to trim her down to her water-line; the extra lift mentioned earlier in this article came in very useful here, as it would have been impossible to achieve stability otherwise without bringing the water-line almost up to deck level. As it is, the model fulfils the first requirement of a gun platform; she is very stiff, and performs very well in a rough sea.

The bridge deck is made removable to provide access to the battery; as will be seen in the photograph, the whole superstructure forward lifts out. Rebates above and below deck are provided, forming a watertight joint—this is very necessary, as the model bores through a rough sea in a very realistic manner. Part of the after-deck is similarly made removable, to provide access to the motor and propeller shaft.

Five coats of "Monamel," rubbed down with steel wool between each coat, gave a very good finish, though a trifle too glossy for perfect

(Continued on page 635)



ELECTRICAL TIMING GEAR

For Circular-Course Racing

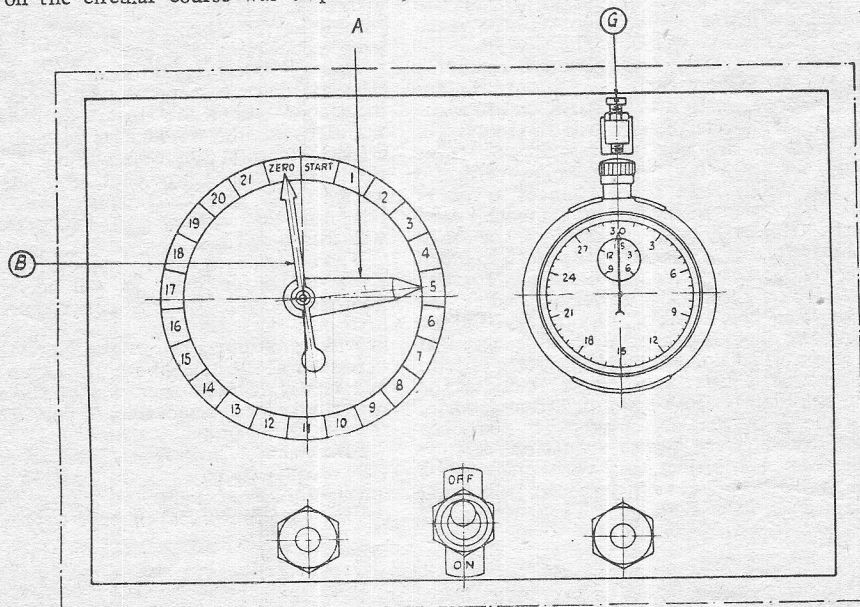
By L. P. Purple



WHEN the Blackheath Model Power Boat Club was reconstituted early this year, an item which assumed paramount importance to the members was the desirability of holding a regatta under M.P.B.A. rules during the current season. At subsequent meetings, the necessity of having some means of timing hydroplanes on the circular course was emphasised,

28th May, 1936. The reasons for adopting this layout were, firstly, that an ordinary stop-watch could be used, and, secondly, any number of laps up to a maximum of 21 (in my particular instance) could be timed.

The construction and wiring diagram of the apparatus is shown in the drawings, but for the benefit of readers who may not be able to refer to



FRONT ELEVATION

and the writer decided to see what could be done in this matter. All the various articles which have appeared in recent years on this subject in *THE MODEL ENGINEER* were perused, and it was finally decided to follow fairly closely the design published by "Artificer" in the issues dated 21st and

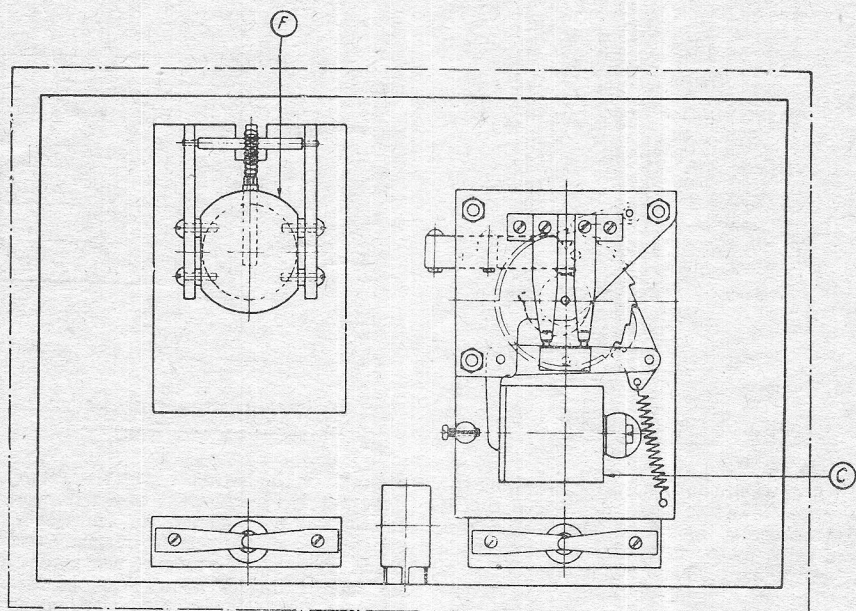
the back numbers previously mentioned, the following is a brief description of the operation of the instrument:—

At the commencement of a timed run, the finish hand (A) is first of all set to the appropriate division on the dial to give the required number of

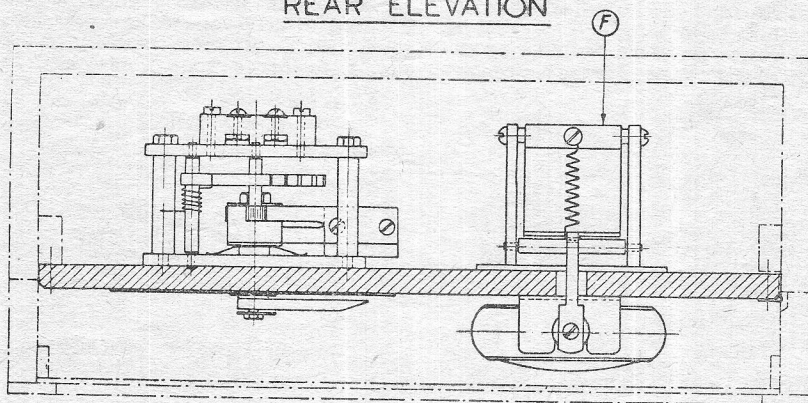
laps and the lap counter hand (B) is in the "zero" position. Contact is made at the first half-lap on the tethering pole-head, and current flows through the electro-magnet (C). This attracts the armature, and hence ratchets the lap-counter hand round one division. Simultaneously, contacts (D) and (E) close, the electro-magnet (F) is energised,

stopped automatically. Press-button switches are fitted to both magnets, to enable the lap-counter hand to be re-set, and also to supply the third pressure to the stop-watch button, which is required to bring it back to its original zero position.

As initially constructed, the apparatus proved



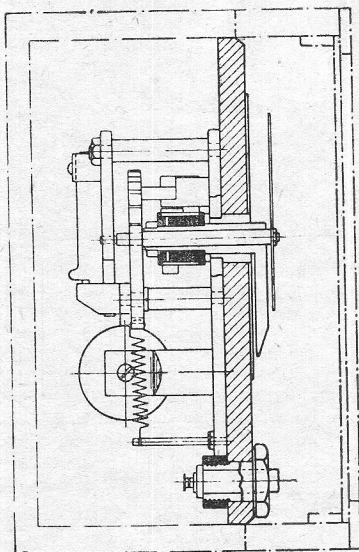
REAR ELEVATION



PLAN VIEW

the armature of which is attracted, and the adjusting screw (G) in the upper limb of the bell-crank lever strikes the press-button and starts the watch. On the completion of each subsequent lap, the lap-counter hand moves round one division until eventually it comes in line with the finish hand. When this is reached, contacts (H) and (E) close, current is again passed through the electro-magnet (F) and the watch is

to have one or two minor defects which occasioned some bother. When current passed through the lap-counting mechanism, the impulse given to the ratchet wheel was sufficient to rotate the spindle two or three divisions instead of one—this occurred when using a 6-volt motor-cycle accumulator, of which more anon. This was positively prevented by fitting a projecting stop to the heel of the operating pawl, which locks the

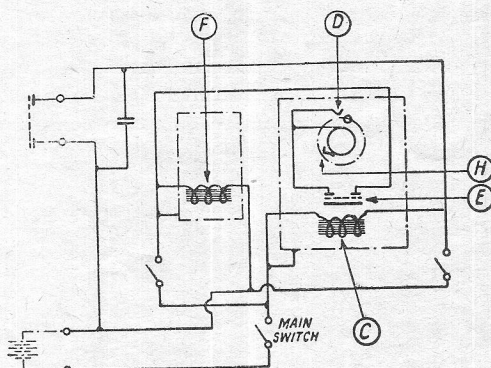
END ELEVATION

ratchet wheel when the armature is touching the electro-magnet. It was then discovered that if the electro-magnet operating the watch was energised only by a very brief contact, made whilst the lap-counter hand was in the process of moving from one division to the next (as recommended in the original article), the time available was far too short to overcome the mechanical inertia in the armature and its bell crank. Consequently, nothing happened.

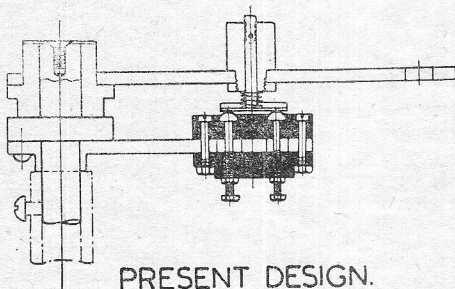
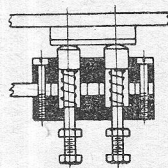
This trouble was overcome by allowing the main contacts to stay closed after the lap-counter

degrees and it was tested up to approximately 2 revs. per sec. (equivalent to a boat speed of 400 m.p.h. on a 100-yd. course) before the stop-watch operating mechanism failed to respond.

A third difficulty arose when, after a search lasting several months, a stop-watch was located and purchased. It was found that the force

WIRING DIAGRAM

required on the button to start the watch was over 4 lb. and that pressures of over 2 lb. were needed to stop and to re-set to zero. This was beyond the capabilities of the electro-magnet, and a very much larger electro-magnet was made, but with no definite improvement. Various ideas incorporating toggle levers, etc., were contemplated, but as the date of the regatta was fast approaching, the crude but seemingly effective method of adding a further 6 volts to the supply, i.e. 12 volts total, met the situation. Actually, on the regatta day, a further 4 volts were added to make

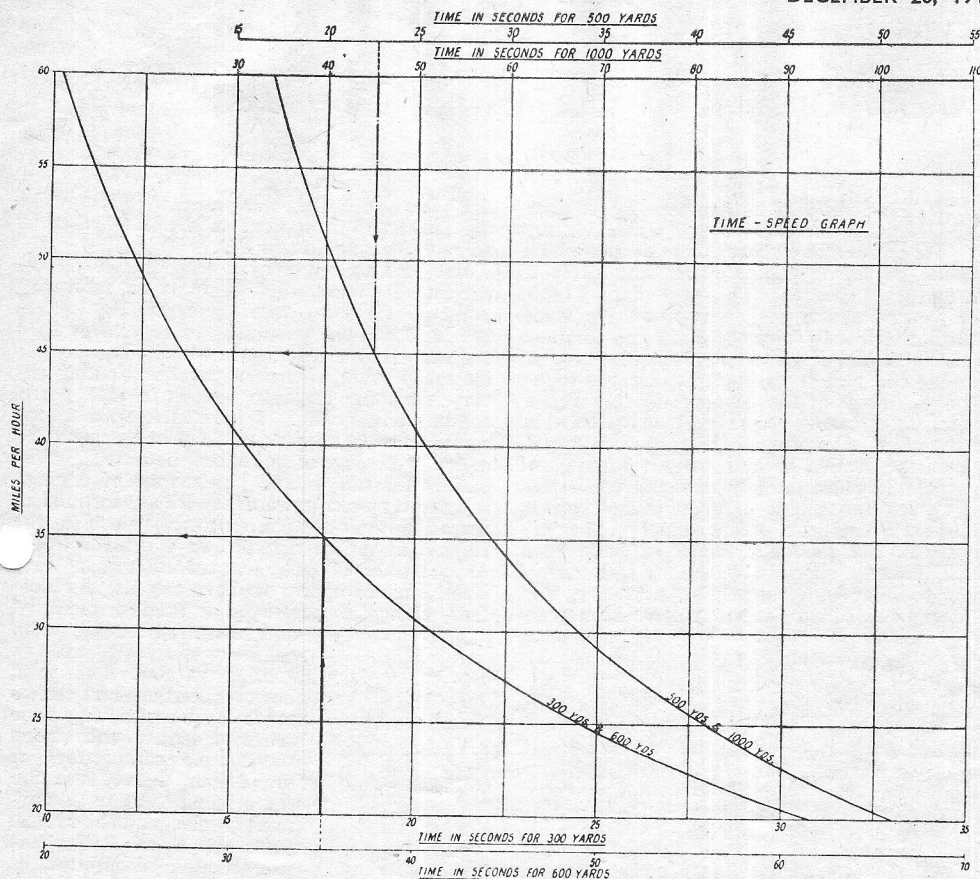
PRESENT DESIGN.PROPOSED REVISION.

POLE HEAD CONTACTS.

had moved one division, and to provide subsidiary contacts on the ratchet bell-crank, which, of course, remain closed as long as the contacts on the pole head are bridged. This gives a long enough closed period to ensure the satisfactory operation of the watch and, furthermore, it can, if necessary, be lengthened by extending the contact plate on the head, i.e. increasing the angle of arc over which contact is made. On the head in use at present, the arc is in the region of 20

assurance doubly sure, and then, of course, trouble appeared elsewhere, this time at the pole head. This was caused by the bridge contact-piece being slightly bent in transit, and causing an intermittent contact. To prevent any possible recurrence of this nature, it is proposed to fix the bridge contact-plate firmly to the pole arm, and to spring-load the two contact studs independently.

As a further aid to announcing quickly the



speeds of the competing boats, a time-speed graph was drawn out giving directly the speeds over both 3- and 6-lap races of 100 yd. per lap. An attempt was made to draw this on long graph paper, as this would have resulted in a straight line graph, but the divisions on the available paper were far too small and hence much too inaccurate. The curve was finally drawn by plotting points for every $\frac{1}{2}$ sec. interval of time, and also every $\frac{1}{2}$ mile per hour of speed, between the limits of 20 and 60 m.p.h. Subsequently a

second curve was added to cover 5- and 10-lap races, i.e. for 500 and 1,000 yd.

In conclusion, I would like to express my thanks to Mr. Benson, our club secretary, who made the lap-counter dial, and to Mr. Liffen, a fellow club member, who constructed the wooden box (which, incidentally, measures $8\frac{3}{8}$ in. long \times $5\frac{5}{8}$ in. wide \times $3\frac{5}{8}$ in. deep) to house the "bits and pieces." May I also be allowed to express the hope that the graph will soon be out of date with its upper limit of 60 m.p.h.

H.M.S. "Ajax"

(Continued from page 631)

realism; this glossiness, incidentally, caused some severe headaches during the photographing of the model, since it was impossible to banish it entirely even with a Pola-screen. It was found that the best way out was to use a strong back-light, with only the bare minimum of light necessary to show detail on the side facing the camera. As a matter of fact, this system of lighting was found to be the most effective in every way.

The only point not at present certain is the life of the dry cells. Up to date, experience would seem to show that the average life is about two weeks of intermittent running which is a good deal

more than was expected, as she did a lot of running during the testing period. Dry cells are not really satisfactory for this type of duty, as the power falls off so rapidly on partial exhaustion. They are ideal for this particular case, however, as the model will be run and maintained by the writer's twelve-year-old son in Victoria, B.C., without supervision. For this reason, the foremost considerations in design and construction have been ruggedness of build, the elimination of fragile detail as far as possible without sacrificing the salient characteristics of the design, and simplicity of operation and maintenance.

"Compensation Without Complication"

By EDGAR T. WESTBURY

A WELL-KNOWN automobile expert once defined a carburettor as "a wonderfully ingenious and elaborate contrivance which supplies a petrol engine with an incorrect mixture at all speeds." This is perhaps a little hard on carburettor designers, who have made prodigious efforts to solve the many and complex problems of carburation, but it is quite true to say that the perfect carburettor has yet to be invented. Most of the advances in carburettor design made during recent years have been in the direction of improving the range of control, so that the flexibility and smooth running of engines, under increasingly exacting conditions of duty, can be ensured. This, of course, applies to full-sized engines; where model engines are concerned, the tendency seems to have been in the directly opposite direction, carburettors having become more and more primitive, and all attempt at control seems to have been prac-

tically abandoned. So far from producing "an incorrect mixture at all speeds," the model petrol engine carburettor is only capable of producing any sort of a mixture at one speed, and while the correct strength of mixture may be obtained by adjustment, depending upon the care and skill of the operator, it remains correct only so long as the running conditions of the engine are constant, any variation of load or speed upsetting the balance of carburation conditions, and altering the mixture strength.

Many, if not the majority, of the users of model petrol engines, however, have been satisfied with this state of affairs, or at any rate have been content to tolerate it as inevitable. This is correct in one accepts the view that the only successful carburettor for small engines is the severely simple type, in which the least elaboration is regarded as a deadly sin. Not a few readers, having had experience of elaborate carburettors which were infinitely worse in every respect than the simple type, may adopt

this view; and if they are content to accept also the faults and limitations of the latter, there is no more to be said about it. But judging by many recent queries on the subject of carburettors, there is an increasing number of readers who are beginning to take an interest in the possibility of controlling their engines. This is a string on which I have harped for many years, though without awakening any very resonant response among model petrol engine constructors. I have developed several carburettors of a type capable of being controlled over a wide range of speed, but these are intended mainly for use on the larger sizes of engines, say, from 15-c.c. upwards, and I am inclined to agree that their application to very much smaller engines might be difficult, or at least delicate. As a matter of fact, few constructors of very small engines appear to have any use for float feed, though I have seen it used successfully,

and to real advantage, on an engine as small as 2½ c.c.

Even without float feed, however, carburettors can be made capable of a fairly wide range of control, and among the simple carburettors of my design, I may mention the original "Atom Minor" mixing valve, and the MODEL ENGINEER Road Roller engine suction carburettor, as examples of devices which provide this facility.

Strictly speaking, control is not the same thing as mixture compensation, though the latter, in some form and measure, is a necessity to enable an engine to be controlled without continual readjustment of petrol and air supply. When the speed of an engine is varied by throttling the supply of mixture, some means must be

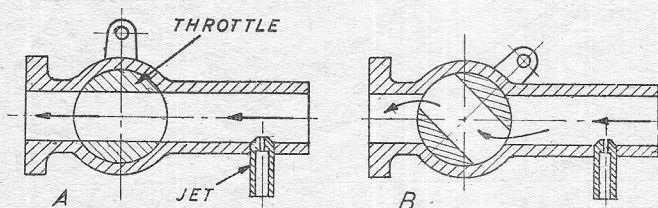


Fig. 1. Air flow conditions in simple carburettor fitted with throttle valve

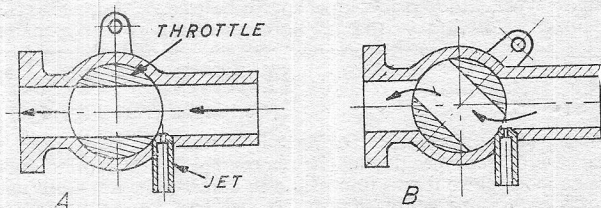


Fig. 2. Effect of bringing the jet close to the throttle valve

adopted for ensuring that the mixture strength remains constant, but the same need remains when engine speed varies, due to a change in load, apart from any change in throttle position.

I have on previous occasions explained how the pressure conditions at the jet orifice affect not only the immediate jet output, but also the

reaction to changes in the air flow through the choke tube. Thus the same carburettor have totally different characteristics according to whether the jet is fed by suction, float feed, direct gravity, or pressure respectively. But when a throttle of any kind is fitted, the behaviour of the carburettor is further affected, and both the type and position of the throttle are important factors in its controllability. Several attempts to fit throttle controls to carburettors, which have been brought to my notice by readers, have been unsuccessful, because these facts are not properly realised.

To illustrate the effect which the throttle may have on the mixture strength under various conditions of opening, take as an example the simple and elementary form of carburettor shown in Fig. 1, consisting of a plain jet in a plain choke tube, with a simple "barrel" or plug cock type of throttle fitted on the discharge side of the jet. This and the other drawings in the present article should be regarded as purely diagrammatic, and intended only to show working principles. The flow of is from right to left, and for the time being,

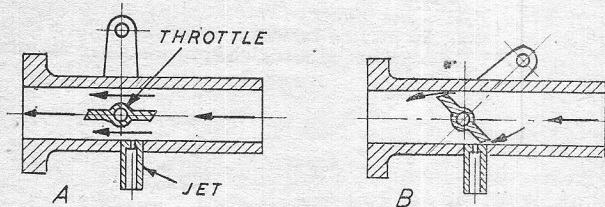


Fig. 3. Simple carburettor with butterfly throttle

we can ignore the effect of such refinements as a variable jet or a venturi choke tube, but it is assumed that the jet is fed by suction.

In A, Fig. 1, the throttle is shown wide open, the passage through it forming a continuation of the main bore, so that the air can move freely through the choke tube. Assume that the engine is running at its full speed, and that the size of the jet is adjusted to produce a correct mixture under these conditions. If, now, the throttle valve is partially closed to the position shown in Fig. 1, B it is evident that the air velocity past the jet will be very considerably reduced, the effect being to weaken the mixture, unless means provided to counteract this in the design of the jet or the method of fuel feed. Carburettors fitted with a throttle in this way are usually very unsatisfactory, any attempt to control the engine speed by means of the throttle causing it to "conk out" altogether. It is this fact that has largely been responsible for the fallacy that throttle control of small engines is impracticable.

But suppose that the jet, instead of being at some distance from the throttle, is placed close up to it, as shown in Fig. 2. In the full open position, A, conditions are no different from those in the preceding example; but when the throttle is partially closed, as at B, the closing edge of the barrel restricts the passage area in the vicinity of the jet, thereby acting as a variable choke tube, and keeping up the air velocity, so

that the mixture strength is maintained. As a matter of fact, the tendency is to keep the jet discharge constant, though the air flow is restricted, so that the mixture becomes richer as the throttle opening is reduced. This tendency, however, can be controlled by slight alterations in the jet position, by introducing the effect of a permanent air leak, or cutting away the edge of the throttle barrel to modify air flow conditions at this point. Herein lies the elements of "mechanical compensation," which is incorporated in many types of full-sized carburettors, often in conjunction with other methods of compensation.

The "Kiwi" carburettor described in THE MODEL ENGINEER some time ago, works on this principle, and although the design incorporates float feed, it is possible to adapt it to suction feed without affecting the control of the mixture by the mechanical action of the throttle.

Importance of Jet Position

In carburettors working on this principle, it is fairly obvious that not only the lateral position of the jet, but also the height of its tip, are highly important. If the jet is designed to screw into the body with a metal-to-metal joint, the fitting of joint washers will upset its location, and *vice versa*. One of the constructors of the "Kiwi" carburettor sought to improve its performance by extending the jet into the centre of the air passage "to obtain a stronger suction"; the result was that when the throttle was closed half-way, the jet was effectively screened and thereby cut right out of action.

Among well-known carburettors which have used a barrel throttle to obtain mechanical compensation may be mentioned the Senspray, the Clandel-Hobson, and that fitted to one of the early Rover cars. Nowadays it is usual to apply some other form of compensation in conjunction with the barrel throttle, to provide for changes of load at a given throttle opening.

Other forms of throttle valves may be used to produce local augmentation of air velocity, and in full-sized carburettors, the "butterfly" throttle is very popular, being simple and cheap to produce, and giving fine control at small openings. As will be seen from Fig. 3, this form of throttle divides the air into two parallel streams, one of which has no effect on the jet if the latter is placed in the position shown, but the other behaves in much the same way as the barrel throttle in keeping up the jet output when the air flow is restricted.

The practical attractions of the butterfly throttle are not so great in the case of very small carburettors, as it becomes difficult to fit, and takes up much more than its fair share of room in the air passage, also interfering with streamlining of the bore. It may be observed that this form of throttle, in particular, should be regarded as a restrictor rather than a stop valve, as it would be extremely difficult to fit it so as to produce an airtight seal when closed.

Several carburettors employ the butterfly

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throttle to bring into action a slow-running or "pilot" jet, though it is not commonly employed to influence the action of the main jet. This, however, was done effectively some years ago in the case of the Capac carburettor, a device noted for its structural simplicity.

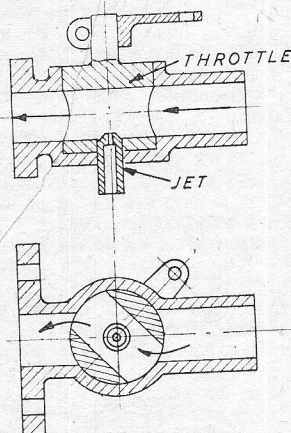


Fig. 4. Throttle arranged to operate on both sides of the jet

It will be seen that the importance of keeping up the air velocity at the jet is emphasised; this is by no means the same thing as keeping up the suction, which is quite easily done by placing the throttle behind (i.e., on the intake side of) the jet. The latter expedient is often used on small carburettors, an intake strangler or "choke" being used for a throttle, but this has the effect of increasing the jet output as the air flow is restricted, and thereby making the mixture far too rich at low speeds; in other words, the output characteristics of the carburettor are completely inverted. This explains why it is futile to attempt to use additional compensating devices, such as submerged jets, in carburettors controlled in this way. Moreover, it is only by maintaining air velocity at the jet that good atomisation can be ensured, and control by suction only is liable to result in a wet or "lumpy" mixture, producing rough and erratic running of the engine at low speed.

To obtain something approaching correct mixture with suction control, the air passage should be restricted both before and behind the jet. The obvious and primitive way to do this would be by using two interconnected throttles, a device which, in some form or other, was often exploited in early German aircraft carburettors. But a much less cumbersome method would be to utilise the two sides of a simple barrel throttle valve, with the jet situated between them, as in Fig. 4. Here the axis of the throttle is in line with that of the jet, so that the latter stands in a central chamber which can be more or less isolated by closure of the throttle, from both the intake and discharge sides. With suitable adjustment of cutaway, this device can be made to work fairly well on the smallest engines, and if the throttle barrel is not made unduly large, the jet is close enough to the edge of the throttle

to take advantage of the air velocity and turbulence in its vicinity. A well-known example of a full-sized carburettor working on this principle was the old White and Poppe, in which the further refinements of an eccentric cap over the jet, to act as a modulator, and a variable air leak through the throttle trunnion, were added.

The well-known plunger-throttle carburettor which is very extensively used on motor cycles, is another version of this form of control. As seen in Fig. 5, the lower edge of the plunger controls both the intake and discharge apertures, and velocity of air past the jet is maintained at low speed, by the restriction in the area of the passage over it. Adjustment of mixture control is by cutting away the edge of the barrel as required, and all motor-cyclists know that this can be varied to obtain the characteristics most useful in particular circumstances, such as good "pottering," rapid acceleration, or maximum power flat-out.

When only one jet is fitted, or the main jet is required to be in action throughout the full speed range, the tip of the jet should be at flush with the floor of the plunger chamber; if either higher or lower, control may be affected. A jet may be cut right out of action by allowing it to project upwards, and providing a recess in the

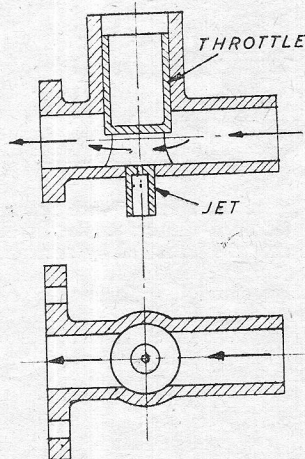


Fig. 5. Plunger-throttle type of carburettor

plunger to fit over it and blank it off at a point. One well-known three-jet carburettor made a special point of "jet damping" by this means, to provide selective and progressive control of the jets.

It should always be remembered by constructors who select the motor-cycle type of carburettor as a prototype (a very common and by no means injudicious choice) that the mechanical control action of the throttle is an essential and indispensable factor in its success; if it is used without a throttle plunger, or the latter is held in a fixed position for normal running, its special advantages cannot be realised. I have found plunger throttles rather finicky in small sizes, and have obtained better results with rotary barrel-type throttles, in most cases.

(To be continued)

A Small Air Motor

By K. N. Harris

I RECENTLY had occasion to carry out some experiments which required the use of a blower-fan, and for certain reasons it was desirable to utilise compressed air as the motive power to drive it. It may be asked: Why not use the compressed air direct? But the experiments were connected with a job in which a fan would have to be used, and the fan was an essential part of the experimental set-up.

I decided on the old-fashioned D.A. oscillating engine, and the accompanying drawings illustrate

this. Though made to work on compressed air, the engine would, of course, run equally well on steam. As will be observed, the engine is considerably more elaborate than the normal commercial job, as it had to stand up to long bouts of continuous high-speed work. The guide for the big-end takes all side stress off the piston-rod and gland; the auxiliary exhausts ports add very materially to the performance of the engine. I carried out some rather interesting experiments with another little D.A. oscillating engine

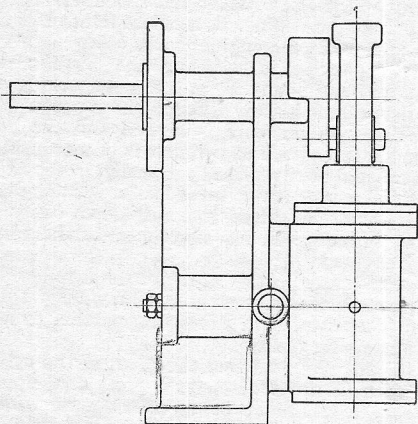


Fig. 1

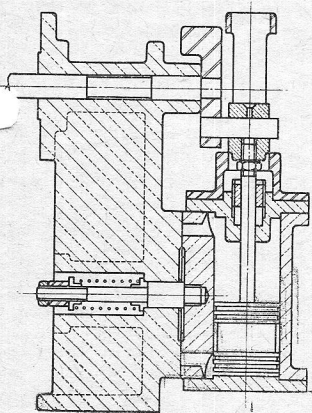
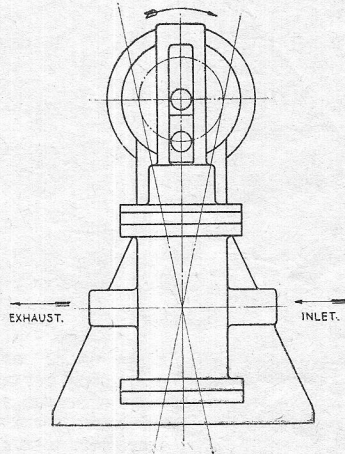


Fig. 2

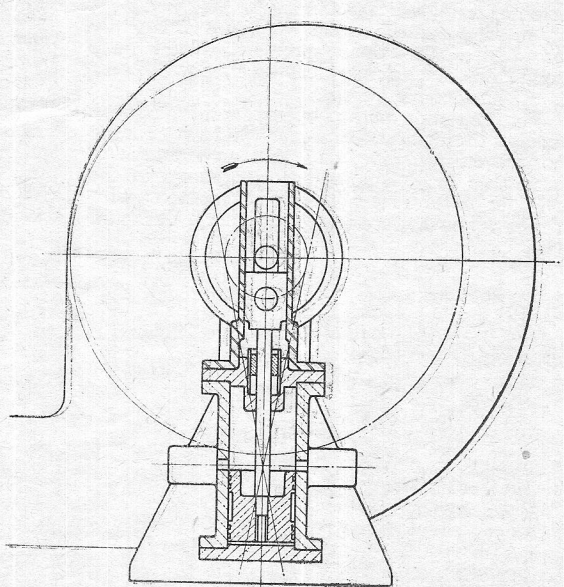


Fig. 2A

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recently. This had an auxiliary exhaust-port passing out steam through the steam-block and was so arranged that the auxiliary port could be put out of use; or, alternatively, the normal exhaust could be similarly dealt with. Tests were made at a set pressure: (a) with both ports open; (b) with auxiliary uniflow closed, and (c) with auxiliary uniflow open and normal exhaust closed.

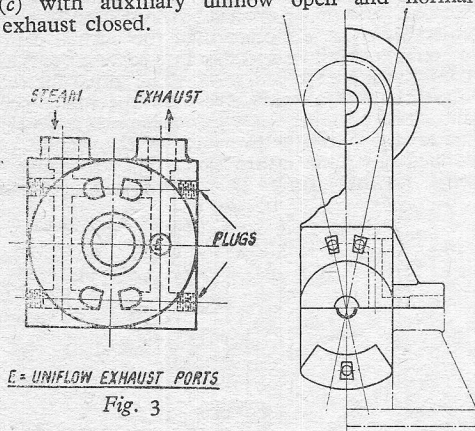


Fig. 3A. Upper part, fixed port face.
Lower part, cylinder port face

Taking the performance under condition (a) as 100, (b) gave a reduction of 25 per cent., whilst (c) only gave a reduction of about 7 per cent. It is the old story of it being easier to get the working fluid into the cylinder than it is to get it out. Of course, with the type of oscillating cylinder which utilises its own movement to distribute steam, steam is admitted pretty well right up to the end of the stroke, which not unnaturally accentuates the exhaust problem. Under such conditions, the auxiliary central uniflow exhaust is of considerable benefit.

Fig. 3 shows a method of leading this auxiliary exhaust through the steam-block and away via the normal exhaust-pipe, and this arrangement is preferable for steam, as the open ports in the cylinder barrel are something of a nuisance; with air, however, they are quite satisfactory. It should

be noted that with the arrangement shown in Fig. 3 the engine cannot be reversed by switching over steam and exhaust connections; as shown in the main drawings, it could be. Fig. 3A shows the arrangements of ports on air motor.

If it is desired to reverse the engine and keep the uniflow port, but at the same time to lead the steam to an exhaust-pipe, then the arrangement in Fig. 4 will provide for this.

With steam, a simple displacement lubricator is advisable; for air, of course, this is useless, and, in my case, a full mechanical scheme not being worth while, I fixed up a container made from $\frac{3}{8}$ -in. bore tube, fitted it with a hand-operated plunger, connecting it to the air inlet by a length of $\frac{3}{8}$ -in. copper tube and a needle-valve. This latter is opened slightly and the plunger gently depressed whenever it is advisable to lubricate the engine. A medium light oil is used, as, of course, the engine works cold.

No packing is used on the piston; with uniflow ports any form of soft packing very quickly finds its way through these ports.

The cylinder bore is lapped and the piston lapped to fit it. The cylinder is of gunmetal, the piston of silver-steel; actually, in the experimental engine it was turned solid with its piston-rod, between centres, roughing-down being done first with a $\frac{9}{16}$ -in. dia. silver-steel bar held in the collet chuck.

The centre portion of the piston is relieved and square-bottomed grooves $\frac{1}{32}$ in. wide \times $\frac{1}{64}$ in. full deep turned in the fitting portion to act as oil-retaining seals.

It will be noted that the pivot of the cylinder is of substantial diameter; great care must be taken to ensure its being dead square with the port-face, and also that the hole in the fixed block is accurately at right-angles to its face in all planes.

Ample bearing surfaces are provided everywhere and the engine is capable of hard and continuous work for long periods without showing signs of wear. It is a case where the inherent simplicity of the type makes its use preferable to that of a nominally more economical but more complicated variety.

A small point is the provision of full floating spring-retaining washers on the cylinder pivot-pin; lock-nuts are provided, too, so that any risk of their working back and reducing spring tension is eliminated.

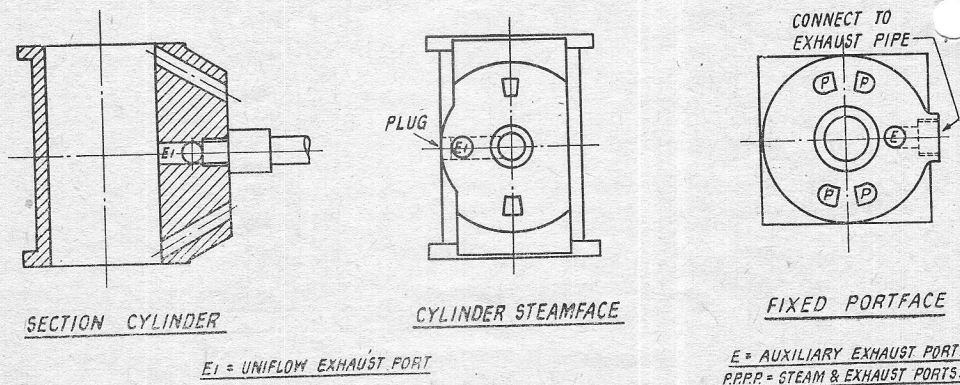


Fig. 4

Motor Ship

A Design for a Proposed Working Model

By Alan V. Burnard

HAVING noticed that there has not been an attempt to produce a design for a working model ship in *THE MODEL ENGINEER* for some time gave me the idea to submit this design.

There are quite a number of model ship-builders who prefer to build a free-lance model rather than a definite scale model of a particular prototype, because of the difficulty of obtaining authentic data. At the same time, I must say I admire the amount of investigation required to obtain minute details.

This design is entirely free-lance, and is for an efficient working model that should be pleasing to the eye when under way.

The model could be built either 3 ft. 0 in. or 6 ft. 0 in. long; for those who have to transport their models to the nearest pond, 3 ft. 0 in. would be the better size. Of course, if one is lucky enough to have a lake or pond close at hand, the 6 ft. 0 in. model would be ideal.

For simplicity, I will describe the 3-ft. model. The dimensions will then be as follows: Length O.A. 3 ft. 0 in.; beam, 6 in. (extreme); draught, $2\frac{1}{2}$ in.; and displacement, 11.5 lb. (Displacement of the 6-ft. model will be $11.5 \times 8 = 92$ lb.)

For draughting the lines a prismatic coefficient of 0.66 was used; this gave a midship section area of 12 sq. in. A trochoid and versed lines curve was not plotted out, but the section areas

when measured up came in quite fair (see lines on the next two pages).

Owing to the superstructure making it possible for the model to be rather unstable, one or two lb. was allowed in the calculations for ballast, so that, if she developed an excessive roll, it would be possible to steady her up, without effecting the designed water-line.

I would suggest that the model would be best planked-up on built-up frames; but the "bread-and-butter" system may be preferred by those who do not feel able to build a planked hull.

Machinery would be steam (in a motor ship!). I suggest a plant consisting of a Stuart 495 boiler and "Star" engine. If these are not available, an S.V. launch engine of about $\frac{5}{8}$ in. bore, and a similar boiler of water-tube pattern, would do just as well. Propeller would be $1\frac{1}{2}$ in. diameter, 3 in. pitch, 3-bladed.

The whole of the midship superstructure would lift off in one piece over the boiler. The forward cargo hold will be removable, as well as the aft one. I think in the actual model the rigging would be rather too complicated; it would probably be better in a simplified form. I know, after an afternoon at the ponds, what it is like to come back and repair bits of rigging that have got ripped off in a desperate attempt to get at a boiler that has run low of water!

New Soldering Preparations

THE widespread applications of soldering processes in modern industries have resulted in many improvements in the methods of applying these processes, effecting a considerable economy in material, time and labour. Among the new ideas in soldering technique, the use of "solder paints" for tinning and sweating has become extremely popular, and has shown as high a saving as 70 per cent. in material and 50 to 70 per cent. in labour costs. The advantages obtainable from these methods, however, are not confined to manufacturing industries, but are equally applicable to occasional or jobbing work in the small workshop.

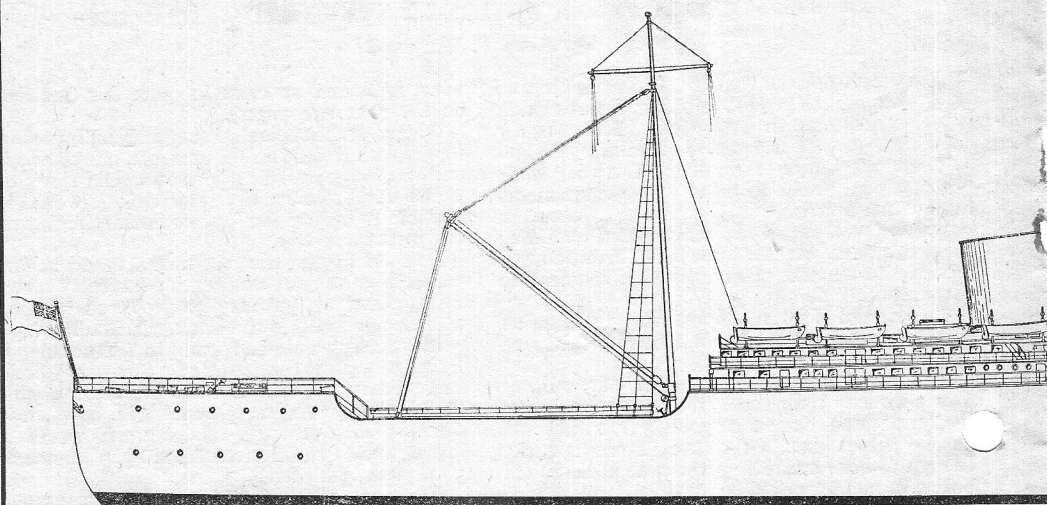
We have recently had an opportunity of testing out three preparations of this nature submitted to us by Fry's Metal Foundries Ltd., Tandem Works, Merton Abbey, London, S.W.19, and find that in all cases they simplify the operations for which they are intended, very materially. "Fryolux" is a solder paint consisting of a mixture of best quality tinman's solder, in powder form, with a paste flux, and is applied to the work while it is cold, by brushing, dipping or spraying. On heating the work by means of a blowlamp, bunsen burner or other convenient method, the solder flows evenly over the surface of the metal, and any residue of flux, or excess solder remaining on the work can be removed by wiping with a

cloth, while the solder is still molten. For removing flux when the work has cooled, a damp cloth may be used, or a special solvent can be supplied.

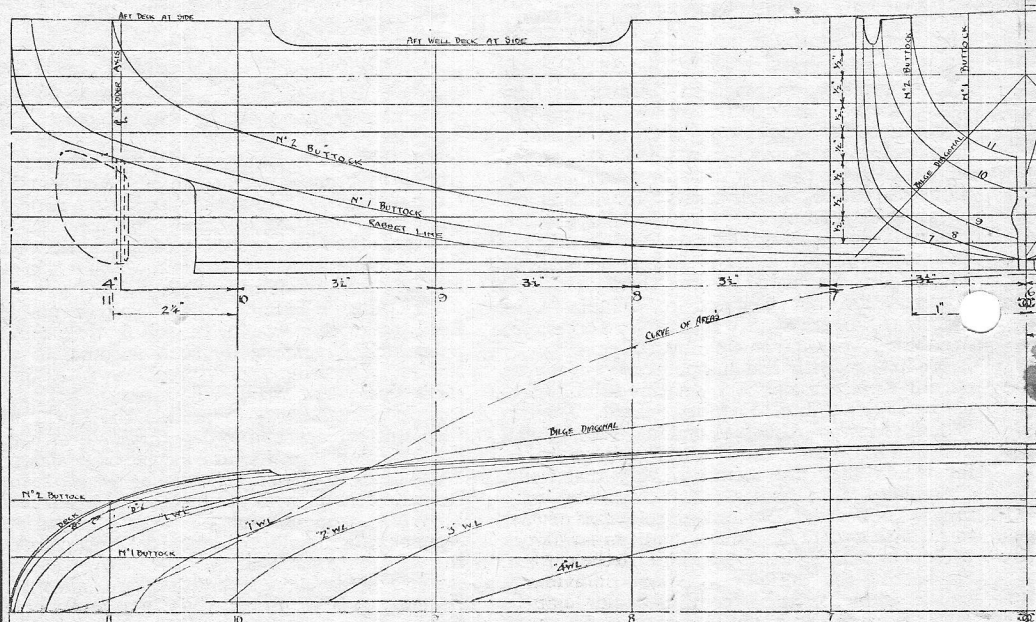
For electrical, radio or delicate instrument work, the preparation known as "Alcho-re" is recommended, in which the flux has a resin base and is therefore entirely non-corrosive; but as this lacks the reducing power of an acid flux, it is only suitable for work which is absolutely clean and free from oxide or tarnish.

"Fryolux" Tinning Compound, in powder form, is more powerful in action than solder paint, and is suitable for such purposes as the tinning of bearing shells, preparatory to lining them with white metal. The method of application recommended is to preheat the work, and then sprinkle on the powder, further heat being applied until it melts and bubbles. A scratch-brush or sharp scraper may then be used to secure intimate contact with the metal, and produce an even adherent coating all over the surface. Surplus flux should be removed before pouring the metal into the bearing.

Fry's soldering preparations are advertised regularly in *THE MODEL ENGINEER*, and may be obtained from most engineers' supply stores and tool dealers, or direct from the manufacturers, at the above address.



Waterline profile for a proposed working model



Hull lines for a working model motor ship. Length. O.A

Selection and Treatment of Steels for Model Engineers

By J. Blackburn

ALTHOUGH the quality of engineering work of model builders has reached a very high standard, the materials used are still selected haphazardly, or as indicated by the type of scrap available, and the result is that unsuitable or inferior materials are used for vital parts, e.g., a low-grade Bessemer steel for an I.C. engine crankshaft, or silver-steel for pins subject to violent shocks. A further trouble is the use of materials, usually steels, in unsuitable states of heat treatment.

For the present, it is intended to confine this series to steel, as the question of heat treatment is usually not important in other common metals. Cast-iron, the other common material used for construction, is usually fairly uniform, and the only variations usually encountered are the alloy or heat treated irons used for cylinder barrels.

A glance at the catalogue of any well-known steel manufacturer will show that since the catalogues have become more and more comprehensive, it now requires a metallurgist to select a steel for a particular use, the very state of affairs the catalogue was designed to avoid. And this, in fact, is precisely what the professional engineer does. However, the question is not quite as difficult as all that, and the application of certain common-sense rules will cut straight through the numerous varieties of steels and substitutes.

Process of Manufacture

The nature of the manufacturing process used in making the steel need not concern the small user unduly, but there are certain facts to be kept in mind. The main processes used and their particular qualities are now dealt with.

(1) Crucible Process

These steels are invariably of the highest possible quality, and it is this process upon which Sheffield founded its great reputation. Uses are edge tools, instruments, high class files, etc.

(2) Acid Open Hearth Process

Sheffield is also the home of this process, although it is used in four other areas of Britain, but not a great deal anywhere else in the world. This also is a high-class steel most often, and is used for forgings, big guns, armour plates, axles, crankshafts, and first-class machinery parts in general.

(3) Basic Open Hearth Process

Steels made by this process can vary from being just inferior to good acid open hearth to very low qualities. This is the "tonnage" process, used for making the majority of the country's steel. Products range from motor chassis and comparatively lightly stressed crankshafts and moving parts, down to girders and structural steels, plates for tinning and corrugated iron. Railway rails are often made

by this process, but also by the acid open hearth.

(4) Acid Bessemer Process

This was Bessemer's first process, and is only used at a few works in this country. The steels produced are usually structurals and rails, and sheets which have good characteristics for cold drawing.

(5) Basic Bessemer Process

The awful qualities of steel which were dumped in this country from Belgium, Luxembourg, France and Germany in the depression were made by this process, which is not much used in Britain. The quality is invariably low.

Type of Steel

The process of manufacture indicates the relative quality of the steel, although, of course, there are many variations in each group. It can generally be said, with some few exceptions, that any type of steel can be made by any process, but naturally, the steels containing the expensive alloying elements are made by the "quality" processes.

Forgetting for a while, the influence of alloys, broadly speaking the carbon steel contains small quantities of silicon, sulphur, phosphorus and manganese, and carbon in quantities varying between 0.05 per cent. and 1.3 per cent. The following ranges are generally used:—

Per cent.		
0.05-0.1	Sheets for drawing and pressing.	
0.10-0.15	Case hardening steel.	
0.2	-0.25	Mild steel.
0.25-0.5	Medium carbon steel.	} Harden- able steels.
0.5	-0.9	Spring and tool steels
0.9	-1.3	Tools, instruments and files

These steels for many years and largely up to the Great War, supplied all the needs of engineers, and by suitable treatment can still provide most of the desirable properties. The reason for the existence of most of the alloy steels is the limitations of the straight hardened steels. These are:—

(1) The low carbon steels, while being very easily worked are of relatively low strength and hardness, and for highly stressed members, low carbon steel would cause the parts to be too heavy. The low hardness means the wearing surfaces soon wear even when running against brass or white metal bearings.

(2) Carbon steels of the high carbon ranges only develop their best properties after heat treatment, and then only by water quenching, which is not suitable for intricately shaped parts. A most serious disadvantage is that the thick sections, when quenched, do not harden uniformly to the centre, and if a piece about 2 in. diameter is tested, it will be found unhardened in the centre. For small tools, carbon steels of 0.8 per cent. carbon, and over, are unbeaten yet, as they are hardened by a simple heat treatment to just as

hard a condition as the most expensive high-speed steel. In heavy machines, where much heat is generated at the tool tip, this latter will soon be tempered to a soft state, while under similar conditions a high-speed steel tool would be unchanged.

(3) In the hardened condition, carbon steels are brittle, and this brittleness can only be moderated by tempering at increasing temperatures, at the same time lowering the hardness.

It will be seen that only reasons 1 and 3 will need to be considered for small work.

The alloy steels, broadly speaking, consist of any member of the whole range of carbon steels with the addition of definite percentages of one or more metallic elements, each of which has a definite influence on the properties of the resulting steel. Thus we may have a nickel case-hardening steel, containing 3 per cent. nickel and 0.12 per cent. carbon, or a nickel oil-hardening steel with 3 per cent. nickel and 0.35 per cent. carbon. The common alloying elements are nickel, chromium and molybdenum, and the usual combination of these alloys in steels are nickel, nickel-chromium, nickel-chromium-molybdenum, chromium-molybdenum and chromium.

The influence of each element cannot be explained by any cut and dried rule, as the elements are all interdependent. While there are many exceptions, the effect of alloying elements is given briefly to help in the selection of steels.

It is necessary to understand that a plain carbon steel consists of a mixture of two kinds of crystals, some being pure iron, and the others alternate plates of pure iron and iron carbide. It will be seen that the latter variety of crystals contain a definite percentage of carbon (actually 0.9 per cent.), and hence, with increasing carbon content, the proportion of this type of crystal increases until, when the steel contains 0.9 per cent. carbon, the steel is entirely composed of these crystals. With more than 0.9 per cent. carbon in the steel the excess of carbon forms the pure carbide, and then the steel consists of the second variety of crystals plus iron carbide. These two kinds of crystals are known to metallurgists as ferrite and pearlite respectively, and the iron carbide in massive form as cementite. It should be noted that this rough generalisation of the crystal structure of a carbon steel is true only of steel in the annealed condition, i.e., not for hardened steels.

Ferrite is soft and ductile, while pearlite is hard and fairly brittle, so it will readily be seen how the properties of carbon steel vary directly according to the carbon content.

Nickel's function is to strengthen the ferrite crystals, thus increasing the strength of the steel in the annealed condition. Nickel also has the property of modifying the hardening properties of the steel so that it can be hardened by quenching in oil, thus lessening the risk of distortion or cracking.

Chromium readily forms carbides with the dissolved carbon in the steel, and chromium carbide is harder than iron carbide. Thus, chromium increases the hardness of the steel and incidentally its tensile strength. Note the difference between hardness and tensile strength.

Molybdenum in ordinary steels is used in conjunction with chromium, as chromium steels have an unfortunate peculiarity in that when tempered at certain temperatures, instead of the toughness increasing steadily, there is an extremely brittle state. Molybdenum obviates this, and also strengthens the ferrite slightly. Molybdenum itself added to a carbon steel improves the resistance to moderately high temperatures, such as experienced in superheated steam work.

While it is not often that the model engineer deliberately buys steel for a particular part of his work, he can at least exercise judgment in the selection of his scrap. He cannot do better in most cases than use the same steel as the professional engineer would use for a similar full-size job.

(1) Structural members.

Use mild-steel in the black or cold drawn condition. In the former case, no heat treatment is necessary, but if any considerable amount of machining is to be done, or holes accurately located, bright cold drawn steel should be stress relieved by heating to 600 deg. C. and cooling slowly. This will put a light scale on the steel which can soon be removed.

(2) Moderately loaded parts, such as axles and steam engine or locomotive crankshafts, carbon steels of 0.35-0.45 per cent. carbon in the "normalised" condition.

(3) Motion pins, gudgeon pins, nickel-chromium case-hardening steels, or in case of small lightly loaded pins, low carbon case-hardening steel will fill the bill.

(4) High duty I.C. or flash steam crankshafts, nickel steel or nickel chromium molybdenum in the fully heat-treated condition. Note that it is a waste of good steel to use an alloy steel in the annealed condition. Probably more petrol engine crankshafts are made from motor car back axles than any other material, and the engineer could not make a better choice.

(5) Small screws and studs for ordinary purposes can be made from "free cutting steel," which usually means a low carbon steel with a high sulphur content, a thing usually to be avoided. In this case, the final product is somewhat brittle, but for ordinary purposes screws made of this material are quite satisfactory. For big end bolts, a good quality material should be used. Medium carbon steel is good for this purpose, as it will screw reasonably easily, and has sufficient strength to carry the high stresses involved.

(6) For tools and punches, etc., high carbon steel hardened and tempered to give properties suitable to the article.

(7) Light springs, high carbon steels. Other springs, silico manganese spring steel or chromium vanadium spring steel. The former may be made from old wagon springs, the latter from good quality automobile springs.

Heat Treatment

It is now necessary to explain the outline of heat treatment, although this is a vast subject and is really explainable only in terms of physical chemistry. The main operations involved are:—

(1) Annealing, consisting of heating the steel to a definite temperature, maintaining it at that temperature for a time proportionate to the thick-

ness of section and cooling slowly, usually in the furnace. This brings the steel into its softest and most ductile form, and in this state it has its lowest tensile strength. The temperature required depends upon the carbon content of the steel.

(2) Normalising is the heating of the steel and holding at temperature, just like annealing, and then cooling in air; that is at a fairly high rate of temperature drop. The effect of normalising is to give a slightly harder and stronger condition, although the ductility is slightly lowered. This is the usual treatment given to heavy forgings, and is specially applicable to the medium carbon steels.

Hardening. To harden steel it is necessary to soak it at a definite temperature depending on the analysis, and cool quickly by quenching in water oil, or even in some alloy steels in air. *The basis of hardening is quick cooling.*

The effect of cooling in oil is to promote a lower rate of cooling, and, hence, less thermal shock to promote cracking or distortion. Plain carbon steels, however, will not harden to glass hardness in oil, but must be quenched in water. This is one good reason for keeping tools as free from abrupt changes in section as possible, and forming good fillets in sharp angles. Air cooling is still less drastic, but few steels will harden satisfactorily with so slow a cooling.

Steel should *never* be used directly in the hardened condition, as while extremely hard (in the case of high carbon steel it will cut glass), it is extremely brittle. As soon as possible after hardening, steel should be tempered.

Tempering is performed by heating the steel to a temperature usually between 150 deg. C. and 650 deg. C., and depending on the degree of toughness required. As the tempering temperature is increased the hardness decreases and the ductility and resistance to shock increases.

Case-hardening is performed by raising the carbon content of the surface of the steel to a depth of 0.005 in. to 0.040 in. The finished parts are packed in boxes in a carbonaceous material made largely from animal charcoal with an admixture of barium carbonate. The high carbon shell increases in thickness roughly at the rate of 0.003 in. per hour. A great mistake after getting a good case is to try to harden it by quenching immediately. The carburising temperature usually used is 950 deg. C., which is too high for good hardening. The piece should be reheated to its correct hardening temperature, quenched and tempered, when both case and core are in good condition.

The obvious question the reader will now ask is, "How can the temperature of heat treatment be found, and kept constant?" Unfortunately, there is no simple answer to this for the amateur. It is not recommended that heat treatment should be undertaken in an open fire; a gas or electrically heated muffle is desirable. All types of thermostatic control for either gas or electric firing are very expensive for high temperature units where the bimetallic strip cannot be used. One alternative is the use of tablets of metallic alloys or salts, which melt at definite temperatures, and are sold for the purpose. Failing this the heat treater must rely on his eye to estimate

temperatures above visible red heat, and the observation of "temper colours" for lower temperatures. The following list gives an indication of the degree of redness of the part:—

Deg. C.		
400	In darkness	} Very dull red.
475	In shade.	
525	In normal daylight	
580	In sunlight.	
700	In normal daylight.	Dark red.
800	" " "	Dull cherry red.
900	" " "	Full cherry red.

An advantage of keeping to the carbon steels is that they are not critical as to a few degrees on each side of the recommended temperature.

Annealing and Normalising

Carbon content.	Annealing temp.
0.1 per cent.	950 deg. C.
0.2 per cent.	900 deg. C.
0.3 per cent.	850 deg. C.
0.4 per cent.	830 deg. C.
0.5 per cent.	810 deg. C.
0.6 per cent.	790 deg. C.
0.7 per cent.	780 deg. C.
0.8 per cent.	770 deg. C.
0.9 per cent.	760 deg. C.
Over 0.9 per cent.	760 deg. C.

The soaking time should be taken as one hour per inch of cross section (not area), e.g., a 3-in. diameter bar will require three hours when the outside has reached temperatures of hardening.

The parts should be heated up and "soaked" at temperature at the rate of one hour per inch thickness of section with a minimum of about ten minutes for any small thickness, and quenched in a vessel containing such an amount of oil or water that the temperature of the liquid does not rise more than 20 or 30 deg. C. after quenching. Water should be just aired before quenching, and if intricately shaped parts crack on quenching, a very thin layer of sperm oil should be poured on the surface of the water. This is an old trick and very effective.

When quenching, immerse the part rapidly, with its smallest cross-section first, and move about with the tongs in a vertical direction so as not to allow bubbles of steam to form on the surface.

Remove from the quenching medium while still hand warm and temper immediately.

To understand the theory of hardening, it is necessary to conceive of the steel when heated to the appropriate hardening temperature, losing its structure of mixed crystals, and becoming a uniform, structureless mass. It follows that this amorphous mass contains the carbon uniformly distributed, in fact, in solid solution. If this mass is cooled suddenly the steel will *tend* to remain in amorphous condition. In practice, the steel does not remain in this condition, which, in fact, is not extremely hard. Between the amorphous condition, and the fully annealed condition described, there are three different structures produced. Their names and properties will be given for reference purposes.

Austenite.—The amorphous condition comparatively soft.

Martensite.—Intensely hard and brittle.

(Continued on page 649)

*COUPLINGS

By
Old Gaumless

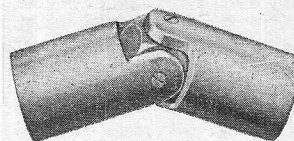


Fig. 1

IF the flexible coupling is the hero by protecting us from mechanical evils, then the "Hooks" coupling is, to my mind at any rate, the villain. I never liked it, and if there is any other alternative available such as a pair of outline bevel wheels, then I fight shy of the Universal. But, unfortunately, there are certain circumstances and conditions where this coupling just has to be used, and I must admit that I admire its fascinating "wobble" when running.

In my "shop" days it was known by various names, the most common being "A Monkey's Elbow," and this description fits it like a glove. It both looks and works like one, doesn't it? That "wobble" which always delights the eye brings us to the coupling's most outstanding

be approximately 88 to 113 r.p.m." The coupling Mr. Hellewell was reviewing was, I believe, of the slotted variety described some time previously by Mr. Westbury, whereas those I intend to describe later are mostly of the fixed pivot type. However, the principle remains the same.

When we use just one pair of "Hooks" couplings, this speed variation can be decidedly awkward, as witness an installation with which I was once concerned. Readers will probably remember one of my letters to THE MODEL ENGINEER in which I referred to an old beam engine installed in a mill at Odsal, Bradford. In this same mill I installed a generator drive by way of cotton ropes and pulleys direct from a line-shaft. When the installation was switched on for the first trial, the intensity of the light given out by the lamps alternately increased and decreased in direct relation to the r.p.m. of the line-shaft. In other words, they flickered badly.

The electrician responsible for the generator portion checked with frantic haste every part of his work, whilst we wandered along the length of the line-shaft. In the very next room we found that our line-shaft was coupled up to the head-shaft at an angle of about 15 degrees by our old friend (?) The Monkey's Elbow. A splendid practical demonstration of the aforesaid speed variation. The cure was affected by installing outline bevel wheels.

"According to Bevan"

Installing a further pair of "Hooks" would also have improved matters, for the couplings could then have been set so as to cancel out each other's variation, leaving the intermediary shaft alone to vary. Let me quote from Bevan's

feature or peculiarity, namely, its speed variation each revolution. There are formulae which can be used in calculating the amount of this variation which alters in relationship to the speed and shaft angularity, but in the space of a short article it would be impracticable to study the whole aspect. For those who desire it, I would suggest that they consult, say, "Bevan's Theory of Machines," where the whole matter is very well considered.

"Ups and Downs"

In THE MODEL ENGINEER dated October 22nd, 1942, our old friend, Mr. John Hellewell, of Luton, contributed an interesting letter wherein he viewed this matter of speed variation as a problem. To quote Mr. Hellewell: "For instance, with shaft angles of 20 degrees and a low speed of, say, 100 r.p.m., the variation will

*Continued from page 436,
"M.E.," October 31, 1946.

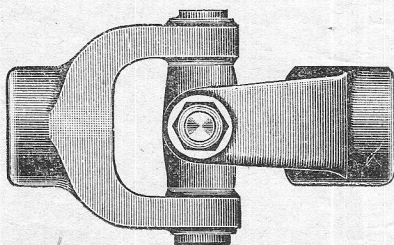


Fig. 2

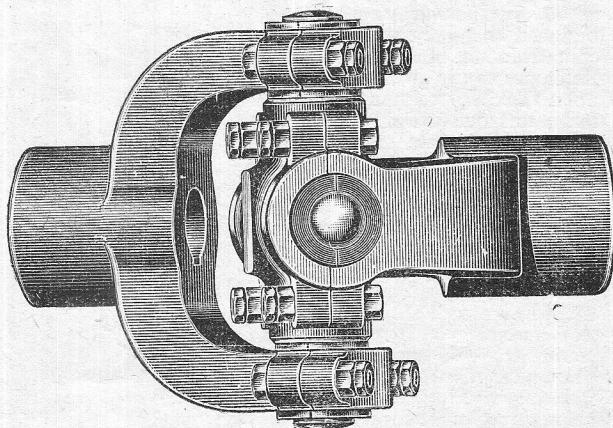


Fig. 3

Theory of Machines—"Since the Universal joint provides a rigid connection between the two shafts so far as the transmission of torque is concerned, the moment of inertia of the masses attached to the driven shaft must be small. Otherwise, very high alternating stresses may be set up in the parts of the joint owing to the alternate angular acceleration and retardation. The larger the shaft angle, the higher is the acceleration, so that this angle should always be kept as small as possible. In some drives, a double universal joint is used. The power is transmitted from the driving shaft to the driven shaft through an intermediary shaft, at each end of which there is a universal joint. If the driving shaft and the driven shaft are equally inclined to the intermediary shaft, and the two forks on the intermediary shaft lie in the same plane, it is

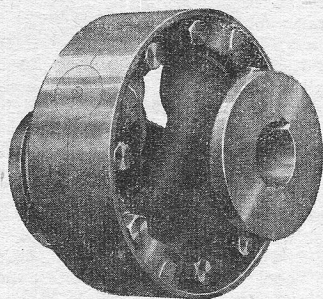


Fig. 4

easily seen that the speeds of the driving and the driven shafts are identical at every instant, and fluctuations of speed are confined to the intermediary shaft, which may be made short and light."

Mr. Westbury also described a number of "Hookes" couplings in *THE MODEL ENGINEER* dated January 28th, 1943, and I have often used similar patterns to those he mentioned in my own models. He also referred to the "Hardy" disc-type coupling, the Rubber Insert Coupling and the "Cardan" coupling, thus slightly confusing the issue, as these couplings are not true universals at all, but flexible couplings, so designed that they will handle a certain amount of shaft angularity. Reference to my previous article upon flexible couplings should make this quite clear. The true "Universal" can, if properly designed, handle shaft angularities up to 45 degrees, and this is something beyond the capabilities of a flexible coupling, even the very latest patterns described in that article.

Wherever possible, bearings should be placed close up to each side of a universal coupling. The reason for this again lies in the coupling's peculiarity already referred to, which results in stresses being set up in the form of a bending moment in the shafts. In his article in *THE MODEL ENGINEER*

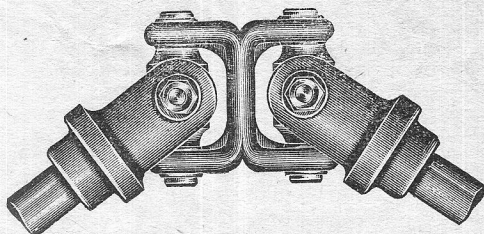


Fig. 5

dated March 25th, 1943, Mr. Westbury referred to this matter of supporting bearings and specifically mentioned the application of universal joints in motor cars, where they performed quite successfully without such support. Once again, however, I must point out that if these couplings are of the disc pattern they are actually flexible couplings, and if of the Hardy-Spicer type of true universal joint, then the unsupported half is usually provided with an extra long splined boss to allow for any movement to and from the fixed half of the coupling. This extra length of boss also helps to support the shaft in lieu of a bearing. Whilst it is true that motor-car couplings work quite well without supporting bearings, it is equally true that they would work much better

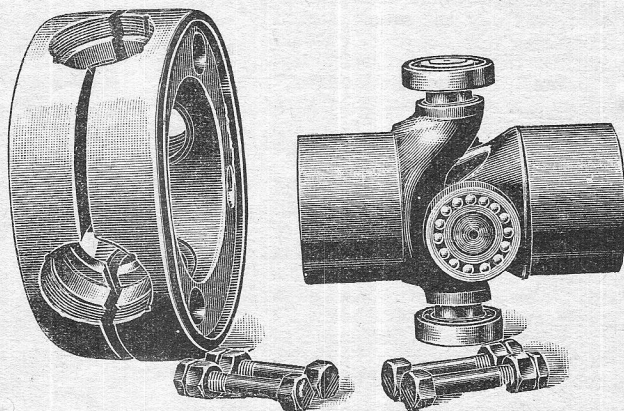
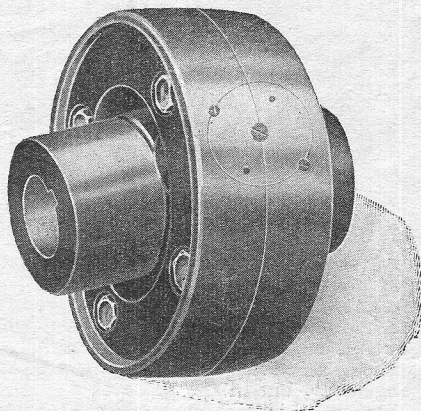


Fig. 6

with them. But where, oh! where, are we to mount a *rigid* bearing

The engine is often mounted upon rubber or hydraulically-controlled springs, and thus bounces all over the place. The chassis itself performs weird and wonderful gyrations, and the back axle is mounted upon separate springs. Upon uneven road surfaces the body distortion can appreciably alter the angles. Quite a lot of motorists have suffered the failure of a universal joint, and I have known cases where such a failure has resulted in the intermediate shaft coming adrift and being actually forced up through the floorboards. A supporting bearing would obviate this.

This lack of rigidity also applies, but in lesser degree, to some of our models such as the lightly-built speed boat hulls to which Mr. Westbury referred, and the construction of these is such that it is next to impossible to provide a rigid bearing support. However, let me repeat what I said before . . . wherever possible . . .

Again referring to Mr. Westbury and his article quoted above, I would stress the remarks he made concerning the desirability of extreme care and exactitude in the making of a universal joint. They have a tendency to "wobble" in any case; in fact, one of their shop names is "wobbler." Any small fault in construction can, at high speeds, result in rapid collapse.

Lubrication is all-important with types having metal-to-metal bearing surfaces, and the safe rule is too much before too little. Finally, although universal joints will work at angles up to 45 degrees, the best results are obtained when the shaft angles are less than 20 degrees, and it

will pay handsome dividends to modellers if they juggle their power plants to keep within this angle.

And now to illustrate a few types of universal joints in use commercially. Fig. 1: A very light type of all-steel construction. It will work at angles up to 45 degrees, but it is not recommended for heavy loading beyond 15 degrees. Many of you will have seen this little fellow, or something very similar, with one half having a long splined boss attached to the traverses of milling machines, etc. Fig. 2: A rather heavier pattern in C.I. with machined bearing surfaces, but here again the working angle is not advised to exceed 20 degrees. Fig. 3: A much heavier type in C.I. with gunmetal bearings, again 20 degrees maximum angle. Fig. 4: Nice-looking job this, for angles up to 15 degrees. C.I. construction with G.M. bearings having removable caps. Note how the body of the coupling is split and bolted together. Fig. 5: A double joint for still greater angles. Fig. 6: Ball-bearing job for high speeds, 10 degrees only. This coupling is shown both complete and dismantled, and the body is split. This arrangement is to ensure ease of assembly and that the bearings will be firmly held when the coupling is bolted up.

In conclusion, have you ever seen hundreds of universals all coupled up together and working satisfactorily? If you ever got hold of an old flexible shaft or speedometer cable, pull it apart and have a look-see!

(Illustrations by courtesy of Crofts (Engineers) Ltd., Bradford.)

(To be concluded)

SELECTION AND TREATMENT OF STEELS

(Continued from page 646)

Troostite.—Softer than above and less brittle.

Sorbite.—Softer than Troostite and less brittle.

If high carbon steel is quenched quickly martensite is largely formed, or if quenched slower, probably most troostite will result. The object of tempering is to break down martensite to a softer constituent, resulting in a tougher resulting steel, while still quite hard. The temperatures of tempering are 150 deg. C. to 650 deg. C., and the lower part of this range is often judged by so-called temper colours. The parts are heated on an iron plate over a gas burner until a bright part of the surface changes colour, owing to oxidation of the steel. Each colour is caused by heating to a different temperature, and it must be emphasised that the colours are indications of temperature only almost irrespective of analysis, and bear no relation to the hardness of steel except for comparison between similar steels.

Colour of Equivalent Temperatures

Light straw, 225 deg. C.; dark straw, 240 deg. C.; reddish brown, 265 deg. C.; dark purple, 285 deg. C.; dark blue, 300 deg. C.

After tempering, the parts may be cooled by any convenient means.

Examples of Typical Heat Treatments

(1) High carbon steel lathe tools.

Finish by forging or machining, leaving only grinding allowance.

Harden in water from 750 deg. C.

Temper immediately at 240 deg. C.

(2) Medium carbon steels for axles, shafts, etc. Normalise from 880 deg. C.

(3) Camshaft made from nickel-chromium case-hardening steel.

Anneal, machine leaving small grinding allowance. Pack in box in carburising compound. Lute on the lid of the box with clay and heat at 950 deg. C. After allowing time for sufficient depth of case, allow the box to cool before opening. Harden the part in oil from 760 deg. C. and temper at 450 deg. C.

(4) Nickel steel crankshaft.

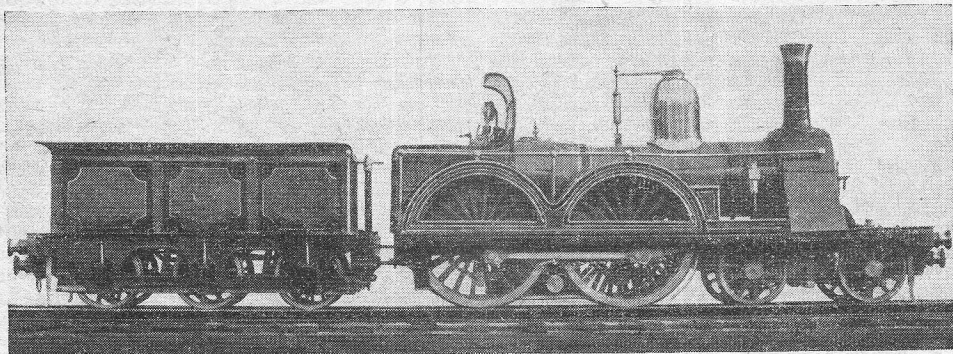
Anneal, machine to rough size, oil-harden from 850 deg. C., temper 600 deg. C. The part will be soft enough to finish machine with low feeds and speeds if the tools are hard enough and of big enough cross section. High duty poppet valves can be made with the same steel and treatment if the usual high alloy valve steels are not available. This is the usual back axle material.

(5) Springs from silico manganese steel should be hardened in water from 770 deg. C. and tempered at 250 deg. C., while chromium-vanadium steel springs are hardened by oil quenching from 870 deg. C. and tempered at 650 deg. C.

(6) Wrought iron can be treated as if it were mild steel, but its use is not recommended for small intricate parts on account of its lack of uniformity.

REALLY OLD-TIME

By H. J. Blake



THE photographs portray a model which I have just completed of *Saltburn*, built by Robert Stephenson, of Newcastle-on-Tyne, in 1862, for the Stockton & Darlington Railway.

Some original drawings of this locomotive came into my possession three years ago and I decided to build a $\frac{3}{4}$ -in. scale model constructed exactly as the original locomotive so far as model making would allow. The model is $3\frac{1}{2}$ -in. gauge, 36 in. long over buffers and 11 in. high.

It will be seen from the photographs that each buffer beam carries four buffers—the two lower ones were used for pushing coal tubs at the mines.

The buffer beams are made of $\frac{1}{8}$ -in. mahogany fitted on each side with steel sheet.

There are no balance weights on the driving wheels. It would appear that balance weights were first fitted to the "Belfast" class, which followed the Saltburn class.

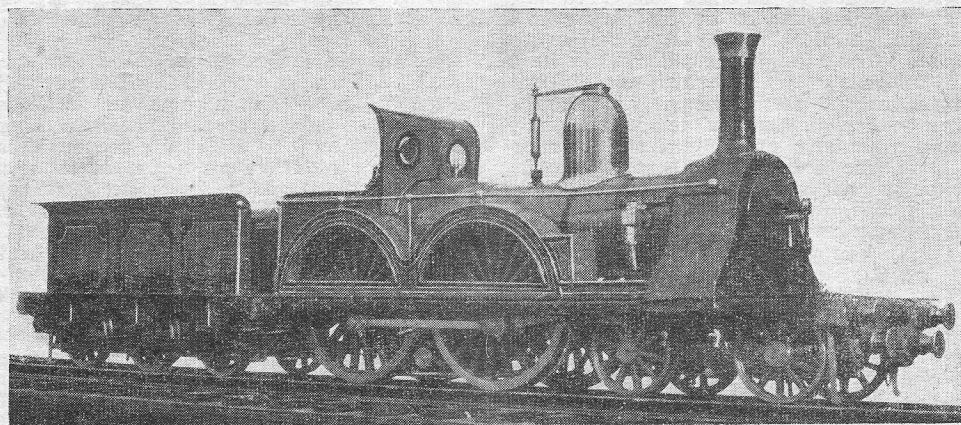
Connecting-rods and coupling-rods are fitted with gibs and cotters.

All springs are built-up laminated type, from spring steel.

A working spring safety valve is fitted in the dome, and a slide-valve throttle is fitted, also in the dome.

Every part of the engine has been made by me, including boiler fittings and patterns for all castings, and the work has occupied all my spare time for three years.

[Editorial Note: Old-time locomotives of the period represented in Mr. Blake's example are really attractive and fascinating, especially if, in miniature, they are built to work properly under steam. The choice of prototype is a very wide one, and nearly every one has its merits, either from the point of view of appearance or as a test of one's skill as a builder of successful small steam locomotives. Apart from this, however, such an engine is always a welcome change from the numerical superiority of modern types.]



“Juliet” ————— By “L.B.S.C.”

Guide-bars and crossheads

THE guide-bars are merely four $3\frac{3}{4}$ -in. lengths of $\frac{1}{16}$ -in. by $\frac{1}{4}$ -in. steel (silver-steel is best, but mild will do) squared off at both ends, and a No. 30 hole drilled through each at $\frac{1}{8}$ in. from one end. They are attached to the flat places at top and bottom of the piston-gland bosses, by a single $\frac{1}{8}$ -in. or 5-B.A. screw in each.

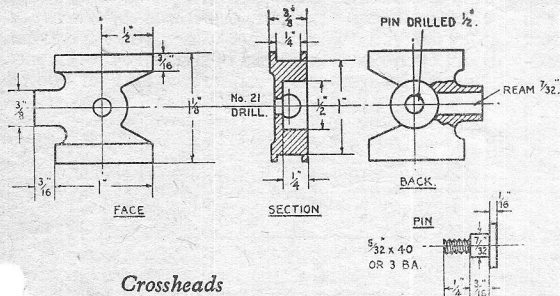
The crossheads are also simple, of a type first suggested by an old friend, Mr. F. A. Tye, now of Watford, many years ago, in which a crosshead-pin with a large flat head is fitted into a pin-drilled recess, giving all the strength of a double-sided crosshead of the usual pattern, but far less trouble to make up. Castings may be supplied for the pair, or they may be made up from $1\frac{1}{4}$ -in. by $\frac{3}{8}$ -in. bar material; steel, bronze, or hard brass will do. Chuck a piece a little over $2\frac{1}{2}$ in. long in the four-jaw; set to run truly, and turn down $\frac{1}{16}$ in. length to $\frac{3}{8}$ in. diameter. Face, centre, and drill No. 4 for about $\frac{1}{2}$ in. depth. Reverse in chuck, and repeat operations. Cut a groove in each narrow side $\frac{1}{4}$ in. wide and $\frac{1}{16}$ in. deep; try a guide-bar in the groove, and see that it slides easily. These grooves can be milled in the lathe by clamping the piece under the slide-rest-tool-holder, at right-angles to the bed, and level with the lathe centres and traversing across a $\frac{1}{4}$ -in. home-made slot-drill held in the three-jaw. I have described how to make these slot-drills several times. Briefly, file the end of a piece of $\frac{1}{4}$ -in. silver-steel like a screwdriver, make a $\frac{1}{16}$ -in. nick in the middle, back off the edges each side of the nick, and harden and temper to dark

pin-drill recess exactly, and lie flush with the side of the crosshead. Ream the bosses with a $7/32$ -in. parallel reamer, so that they will fit tightly on the piston-rods.

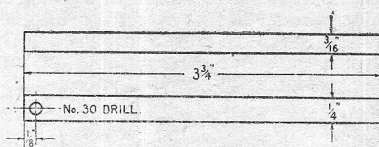
Guide-yokes or Motion-brackets

Castings will be available for these, and all they need is a little attention with a file. Clean up the side of the lug that fits against the engine frame, and file the two nicks for the guide-bars. Drill three No. 30 holes in the lug for attachment to frame, and one each in top and bottom guide-bar supports. If the casting is at all rough, smooth it off for sake of appearance.

The yokes can be built up if desired, using a piece of $\frac{1}{8}$ -in. steel, same as used for frames, measuring $1\frac{1}{2}$ in. by $2\frac{1}{4}$ in. File to the shape shown. The lug for attaching to frames can be made either from a piece of 1-in. by $\frac{1}{8}$ -in. angle, $\frac{1}{2}$ in. long, riveted to the main part of the yoke, or a piece of $\frac{1}{2}$ -in. by $\frac{1}{8}$ -in. flat bar, 1 in. long, brazed or silver-soldered at right-angles to the yoke. The supports for the guide-bars can either be small pieces of angle riveted to the yoke, or little pieces of flat bar, say, $\frac{1}{8}$ in. by $\frac{1}{4}$ in., brazed or silver-soldered to it, end on, above and below the nicks for the bars. Don't forget that these nicks must be made so that the bars are dead parallel for their full length. That is where the fitter's skill comes in! Judging from correspondence, many beginners think the bits of a locomotive should fit together like a jig-saw puzzle, or a set of radio components, and don't seem to realise that



Crossheads



Guide-bars

yellow. I find that they cut faster and cleaner than the usual multi-edged commercial endmill.

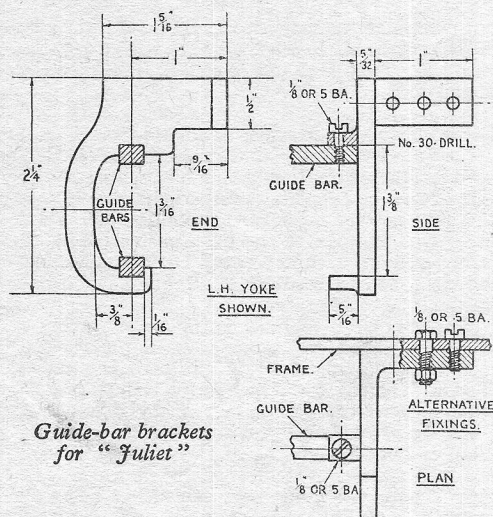
At $\frac{1}{16}$ in. from each end of the piece, on the centre-line, make a centre-pop and drill right through with a No. 21 drill; be certain the drill goes through square with the sides. Then open out to $\frac{1}{4}$ in. depth with a $\frac{1}{2}$ -in. pin-drill, another gadget you can make for yourselves in a few minutes. Saw the piece in half, file the ends as shown in the illustrations, and, if you so desire, recess the outside $1/32$ in., as shown, for sake of appearance, but this makes no difference to the working. The crosshead pins are turned from $\frac{1}{2}$ -in. round mild-steel, to the dimensions given on the detail sketch. The head should fit the

judicious use of both tools and noddle is called for!

Connecting-rods

These are made from two $6\frac{1}{2}$ -in. lengths of $\frac{1}{4}$ -in. by $\frac{3}{4}$ -in. mild-steel bar, by the same process as is used for coupling-rods. The big-end is drilled $13/32$ in. and has a flanged bronze bush pressed into it, the total width being $\frac{3}{8}$ in. bare. The little-end is drilled $\frac{5}{16}$ in. and has a flush bronze bush pressed in. Tip—when making the bushes, drill slightly undersize, and poke the reamers through after the bushes have been squeezed home, using the vice as a persuader. Both bushes should be exact fits on their pins,

running freely without shake. The little-end boss should easily fit the recess in the crosshead; and when the crosshead-pin is put in, and nutted-up tightly on the outside, the little-end should be free to move up and down around the pin, but



Guide-bar brackets for "Juliet"

with only the weeniest bit of side movement. Don't forget to drill a $\frac{1}{16}$ -in. oil hole in the big-end boss.

How to Erect

Take off the steam-chests and put the cylinder port blocks through the frames, holding in position with a toolmaker's cramp whilst you drill the frames with No. 21 drill, using the holes in the cylinder-flanges as guides. Couple up the connecting-rods to crossheads, and put the latter between the guide-bars, pushing the crosshead-bosses temporarily over the ends of the piston-

the lug No. 40 instead of No. 30, and after temporarily clamping in position put the No. 40 drill through frames as well. Remove yoke, tap the holes $\frac{1}{8}$ in. or 5 B.A., open out the holes in the frames with No. 30 drill, and fix with cheese- or hexagon-head screws put through from the inside.

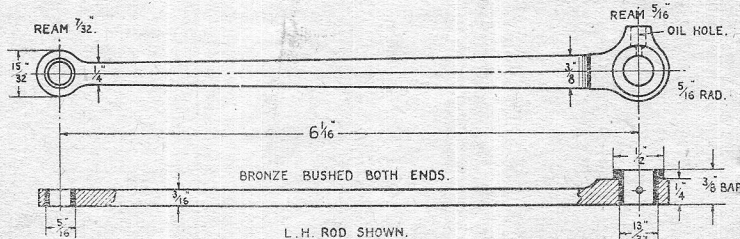
Line up the guide-bars with the small lugs, and put a small cramp on, or else keep the crosshead at the end, which will hold them in place. Put a No. 30 drill down each hole, make a countersink on the bar, and follow up with a No. 40 drill, but shift the crosshead before it breaks through, or the groove will be damaged. Tap the hole $\frac{1}{8}$ in. or 5 B.A., put in a screw, and file off any of it that projects between the bars, so that the crosshead is free to pass the screws.

Push each piston-rod into the cylinder as far as it will go, the pistons touching the front covers. Put one of the cranks on front dead centre, so that the crosshead-boss goes over the piston-rod, then advance the piston-rod into the crosshead by another $\frac{1}{32}$ in., which will give that amount of clearance between the piston and cover. Drill a No. 43 hole right through crosshead boss on piston-rod, and squeeze in a pin made from $\frac{3}{32}$ -in. round silver-steel. The big-end is stopped from coming off the crankpin by an ordinary commercial nut and washer.

How to Set the Valves

Put the steam chests in position, fixing by two temporary screws, and leaving the covers off. Couple up the eccentric-rods to the valve crossheads or forks. Tighten the stop-collar set-screws in any position on the axle, turn the wheels by hand, and watch the valves. If both ports don't open the same amount, adjust the valve nuts until they do, by pulling out the pin in the valve crosshead and turning the valve spindle, which advances the nut, or retards it, whichever way the valve wants to go. When you have equal port openings at each end of the valve movement, loosen the stop-collar set-screws, and set one of

Connecting-rod



rods; then put the cylinders in place on the frame, with the connecting-rod big-ends on the crank-pins, and fix the cylinders with $\frac{5}{32}$ -in. screws or bolts, with nuts inside the frame. Turn the wheels so that one crosshead is at the outer end of the guide-bars; then put on the guide-yoke, level with the end of the bars, and the small lugs lining up with the bars. Hold in position with a cramp, whilst you drill the holes in the frame, using those in the main lug as guides for the drill. The yokes are attached to the frame either by $\frac{1}{8}$ -in. bolts or nutted screws, or screws without nuts. In the latter case, drill the holes in

the cranks on front dead centre. Turn the corresponding stop-collar in a forward direction until you can just see the edge of the front port showing as a black line at the lap of the valve; then tighten the set-screw. Now turn the wheels a complete revolution backward, until the crank is on front dead centre again. The other shoulder of the stop-collar should have caught the pin in the eccentric, and the port should just be "cracking" again. If no port is showing, and the wheels have to be turned further around before the black line appears, the shoulder is too far back, and must be packed out, which can easily

be done by soldering or screwing a little piece of sheet brass, or a block, to the shoulder. If the port is opened more than a crack when the crank arrives at dead centre, the shoulder is too far forward; chip a little bit off it with a small chisel. When the ports crack at each end, on dead centres, in both directions, the valves are correctly set, and the steam-chest covers can be put on. Next items, steam and exhaust pipes, and lubricator.

"Hielan' Lassie"

The Final Brazing Job

Whilst the brazing operation on the foundation ring, backhead flange, and bushes is the last, it certainly isn't the least, but all those good folk who are not scared of a five-pint or larger blowlamp going full blast have nothing whatever to fear. I've done many similar jobs before going over to oxy-acetylene equipment and got so hot that the buttons on my overall coat became too hot to touch, and a fountain pen inadvertently left in the top pocket assumed the shape of a sausage (I'd better not say banana!); but that was because it was done indoors—not in my workshop, but the domestic scullery—on a rainy day. If you can possibly do the job outdoors, or in an outhouse, garden shed, or even an ex-air-raid-shelter, it is much to be preferred. The "fumes" will rust up every bit of bright steel with which they come in contact; and they aren't exactly good to inhale, either. At the same time, if you don't get your face too close to the job, there isn't the slightest risk of being gassed!

Put a bit of fresh coke in the brazing pan, also get the tin tray or pan with the hole in it which was used for the smokebox tubeplate. If the hole is a tight fit on the barrel, make it dead easy with about $\frac{1}{4}$ -in. clearance ("five-eighth-fitter's" fit, that!) and prop it up on a couple of bricks, or other support, which may be handy and convenient, so that, if the boiler barrel is poked downwards through the hole, the backhead is at a convenient height from the ground, to operate on. Then anoint all the joints with wet flux; if using Boron compo for your spelter work, put some all around the foundation ring and backhead flange. Use either borax-and-water for silver-solder, or "Tenacity No. 3" for Easyflo, for the firehole ring flange and all the bushes. Have all your tools and brazing material handy, so that you don't have to stop and look for anything, and risk the job cooling off. Also have some extra coke handy, and a small shovel or scoop for use with same.

Lay the boiler lengthwise in the pan, on its back with the barrel to your left, and pile some coke around it, to the level of the foundation ring. Put some bits of asbestos (cubes, broken gas-fire elements, or anything similar) in the firebox almost to the level of the ring, and put a piece of sheet asbestos over them to protect the inside joints of the firebox and combustion chamber. If you have a small blowlamp as well as the big boy, get that going as well; every little helps. Make certain they won't die out on you for want of oil whilst the job is in progress; then you are all set for the great adventure.

The "technique" of this job is similar to that of the previous job, but this time you really do need plenty of heat, as the whole boiler must be well hot. I've often said in jest that, when you can see the tubes through the boiler barrel, it's just hot enough; but, joking apart, you won't stand any risk of burning an assembled boiler the size of the "Lassie's" with a five-pint lamp or its equivalent in ordinary air-gas blowpipes. Even with the oxy-acet., it would be a difficult matter; all being well, when I shortly arrive at the boiler stage of the $3\frac{1}{2}$ -in. gauge "Bantam Cock" which I am now building "in parallel" with old "Grosvenor," I shall use the biggest tip in my "Alda" set, the 1,000-litre. As before, heat up the boiler at the firebox end, until all the piled-up coke glows red; you can put the smaller lamp, if available, on the opposite side, to help keep the coke glowing. Then concentrate on the corner of the foundation ring nearest you. When this reaches medium red, dip the stick of spelter in the dry flux and apply it to the copper. If it doesn't melt and run after a second or two, the copper isn't hot enough; give it some more "heat treatment." If the stick doesn't start to melt at bright red, it is a bit shy of starting; a touch of coarse-grade silver-solder applied directly before the spelter will teach it manners.

Once the metal starts to flow, it will keep flowing, so advance the flame a little along the ring, in the direction in which the flame is blowing, and feed in a little more spelter, continuing the same way until you reach the throatplate joint. If you have bent out the firebox plate to meet the throatplate, as shown in the longitudinal section, this part of the job will be equal to the airman's famous "piece of cake," as there isn't such a lot of metal to keep hot, and the spelter will flow freely into the joint between inner and outer plates. If you have left the inner plate straight, and put a piece of square copper rod in, as given for the alternative, you'll have to "wait for it," same as when doing the side seam.

The continuation of the job from the farther side of the throatplate is a matter of choice. A "cack-handed" boilermith will probably prefer to take the blowlamp in his left hand and work backwards towards the backhead. An ordinary right-handed individual would, I fancy, do best to come back to the starting point, heat up again, first go along the piece of ring between backhead and firebox, and turn the corner and proceed ahead along the other side of the firebox. Although I can use both hands equally well on most jobs, I usually adopted the latter course in "blowlamp days." Anyway, watch one point, whichever way you go. When the circuit is complete, take mighty good care to heat up the last bit, so that there is a perfect joint between the starting and finishing points. Beginners and inexperienced workers are apt to forget, when they arrive at the "winning post," that the "starting gate" has been out of range of the blowlamp for some little time, and has cooled off sufficiently to prevent the spelter amalgamating properly with it. Unless the flame is played on the cooled-off part for a time sufficiently long to bring it to the original temperature, the molten spelter will just stick to the surface, and you'll

have a fine Welsh vegetable growing there when the boiler is steamed up. It *may* seem sound on the cold water test; but wait until the expansion and contraction stresses, under working conditions, get busy! Another point is that plenty of flux is needed at the point mentioned, as there may be a little oxidation resulting from the first heating, if the job hadn't sufficient flux applied to it in the first place.

Quick Work Needed Here!

Grab the boiler with the big tongs, lift it clear of the long pan, and pop it, barrel downwards, through the hole in the auxiliary pan, shovelling some coke around as quickly as you can, piling up same to the level of the backhead. Then get the coke glowing; and when it is well red, start at the bottom of the backhead, and work your way all around, exactly as described for previous seams. Don't hurry; see that the spelter runs well into the joint between backhead and wrapper before you move the flame along for the next inch. Take the same precaution when arriving at the terminal point.

Next, play the flame straight on to the firehole ring; and when this and the surrounding metal reddens, dip your stick or strip of silver-solder into the flux and apply it to the flange. Silver-solder, especially "Easyflo," being very fluid, it will run around and "sweat" in. Give the regulator bush a dose of the same medicine. Then make another snatch-and-grab raid, and this time deposit the boiler in the long pan, rightway up. There will be no need to pack any coke around this time, for if the blowlamp flame is directed straight on the bushes in turn (dome ring and safety valves) it will provide enough local heat to melt the silver-solder when applied. Finally, let cool to black, and deposit the boiler in the pickle. As the acid enters the interior of the boiler first time and touches the hot "innards," it usually

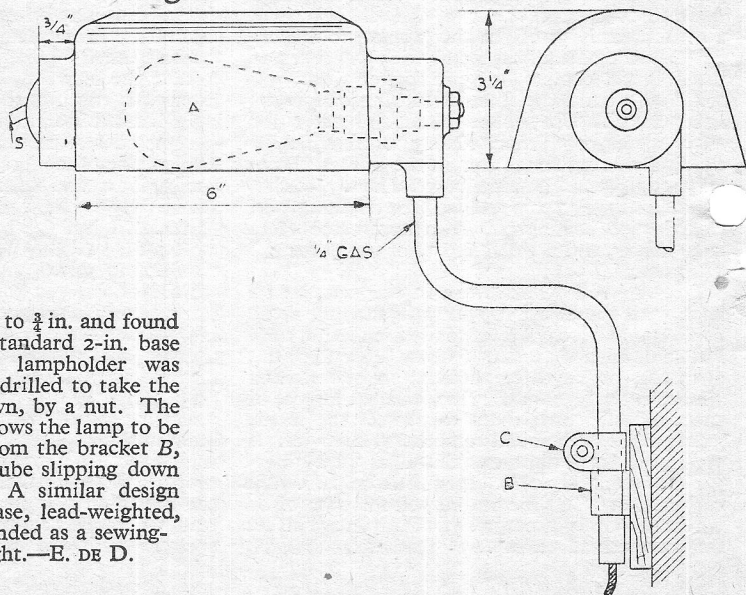
blows out again in double-quick time, so take all precautions against splashing. By the time of "second entry," the shell and tubes have cooled sufficiently to allow the acid pickle to stay in. Leave the whole issue in the pickle for 20 minutes or so, then fish it out with the big tongs, and well drain it before proceeding to the kitchen sink for washing inside and out. If any pickle spots are dropped on floor, mats, or lino, it will do them a bit of no good, and you don't want to upset the good lady and give her any valid excuse for "going for you," if only verbally. For my own part, I have a tap outside the "Crystal Palace," as we call our glass lean-to, and a short length of hose attached, so all I have to do is lay the boiler in the gully, and do a bit of N.F.S. practice on it.

The boiler can then be given a rough test, to ascertain if there are any pinholes in the brazed joints, in much the same way as you test a car or cycle tyre for punctures. Turn up an adaptor to screw into one of the safety-valve bushes, from any odd bit of brass, and solder a tyre valve—or the screwed part thereof—into it. Plug the rest of the holes; bits of wood screwed into tapped bushes, making their own thread, *as O.K.*, and a big cork in the dome hole will do the trick if you tie a bit of string around the barrel and over the cork, so that it doesn't blow out. Couple a tyre pump to the adaptor, and put the boiler in the family bath, or anything else that might be available, with enough water to cover it. Pump some air in the boiler, about 20 lb. or so, and if there are any faulty places in any of the joints, a string of bubbles will mark the spot. There is no need to reheat the whole bag of tricks to stop a pinhole; just drill it No. 55, tap 10 B.A. and screw in a stub of threaded copper wire with a smear of plumber's jointing on the threads. Screw about $\frac{1}{16}$ in. of the wire, and turn it until it breaks off in the hole.

A Light for the Lathe

THE lathe light shown in sketch was made mostly from scrap and has proved most useful, especially in avoiding eye-strain.

The lamp body is an aluminium casting used in pre-war days for sign-lighting and now obtainable from most surplus-store dealers. The left-hand ring extension was cut down to $\frac{3}{4}$ in. and found to house just nicely a standard 2-in. base tumbler switch. The lampholder was soldered to a $\frac{3}{8}$ -in. rod drilled to take the cable and fixed, as shown, by a nut. The swan-neck $\frac{1}{4}$ -in. pipe allows the lamp to be swung over the lathe from the bracket B, clip C preventing the tube slipping down through the bracket. A similar design with substantial oak case, lead-weighted, has been highly commended as a sewing-machine and reading light.—E. DE D.



Letters

Steam Colliery Winders

DEAR SIR,—Mr. F. J. Lewitt might be interested to know that there are two old steam winders at Elmore Colliery, Herton-le-Hole, Co. Durham, both working on 30lb. 1 sq. in. pressure. The newest is built by Stephenson, and is about 80 years old. The other is about 115 years old, has radius link crosshead guides, and a valve-gear worked by hand levers in conjunction with a type of camshaft. I am very vague concerning the details, but this engine must now be a rarity, though still working well, and worthy of interest.

Yours faithfully,

Carlisle.

S. N. WALTON.

Model Electric Traction

DEAR SIR,—In brief acknowledgment of Mr. Prigmore's interesting comments, may I respectfully point out that despite the broad entation, I endeavoured to keep within the confines of the title and the practical issues involved.

For that reason I used the term rheostatic braking to eventually lead the reader to that form of regenerative braking used on some industrial and mining locomotives, which in many respects have something in common with our problem.

I am open to correction, but I feel certain that D.B.H.P. is not the comparative figure a modelist would seek, since it excludes a portion of the work done by the locomotive. I fear that with so many variables and an uncertain knowledge of resistances one cannot hope to suggest a precise figure for the power required. Adding to the complexity is the known fact that, generally, "full-size" formulae are not necessarily applicable to small editions. I look forward to the day when model engineers may have on hand dependable design data from their own collated records.

Yours truly,

"H.J.H."

A Tribute to "Smoke Rings"

DEAR SIR,—It was most pleasing to read in "Smoke Rings" our old friend Percival Marshall's encouraging remarks to model experimental engineers. What an excellent heading "Smoke Rings." I suppose more heart to heart confidences have been exchanged through the medium of "Smoke Rings," than from any other.

As I look back over the past 72 years, I bring to mind the knowledge and happiness rings of smoke have given me. I picture as a child an uncle, a shipbuilder, thrilling me with most wonderful yarns whilst he puffed at his long churchwarden pipe. Later, when I was six years old, he took me over a beautiful ocean-going steam yacht, which was built in his yard.

I picture him sitting in the engine room, and between the mouthfuls of smoke, explaining the value and use of the compound engine. It was, indeed, one of the most interesting afternoons of my life. Later, he took me for trips on

three different tugs, further to illustrate his lesson.

That conversation aroused my life interest in compounding, which still exists, for I am convinced that Monsieur Chapelon, chief designer of the French Railways, is one of the most advanced locomotive engineers of the present time. It was through the smoke rings of a cigar that, in 1883, I was introduced to the late Mr. Francis Webb, then chief engineer of the L. & N.W.R.

So I could carry on with many such illustrations, but one which affects us both was that little meeting off Farringdon Street, when Tennant, A. M. H., Solomon, Sanderson, and our two selves, met and formed the Society of Model Engineers. A historic occasion, and in the atmosphere of friendly smoke, our hands met for the first time. Was that the origin I wonder of your inspiration "Smoke Rings?"

Most model engineers at that period were experimental mechanics, for we were devoid of "Words and Music." We had to experiment and find out for ourselves. I think we were the better for the experience, because it taught us patience, perseverance, and above all, sympathy for the other fellow.

There is still a large scope for the experimental engineer in many subjects. As regards model locomotives for instance:—boilers with and without combustion chambers. The late Mr. George J. Churchward carried out several experiments with combustion chambers before he decided upon the present G.W.R. standard boiler.

Again, the use of large exhaust passages, reducing exhaust friction, etc., as compared to the moderate passages generally used in model cylinders. In large practice, Mr. O. V. Bulleid has recently rebuilt the Southern Railway 4-cylinder 4-6-0 Nelson class, with new cylinders, having much larger ports, particularly on the exhaust side; the result being that an indifferent class of locomotives have been converted to really efficient machines.

Even, at my age, I am now experimenting with Petticoat pipes in the smokebox, and the results, so far, are proving interesting. Before I pass hence I should like to see developed a satisfactory model locomotive testing plant; then future model engineers would be able to obtain accurate data re the performances of their various creations. I am glad to say that there are several friends who are considering this matter seriously.

In conclusion, I hope that model engineers will never let little differences develop into bitterness, but always bear in mind that "Smoke Rings" brought us all together, and so let "Smoke Rings" always keep us a band of friendly workers.

Yours sincerely,

North Finchley.

"UNCLE JIM."

[Mr. Crebbin asks me to convey to his many world-wide friends and correspondents his most cordial good wishes for their health and happiness in the New Year.—P.M.]

Clubs

Mancunian Model Engineering Society

There will be no club meeting on Friday, December 27th, otherwise meetings will be held as usual each Friday evening, 8 p.m., Girls' Institute, Mill Street, Ancoats, (next Ancoats Hospital). Visitors and prospective members welcomed.

The mock auction, held November 29th, was a huge success from all angles. Particulars of membership, etc., J. MEADOWS, Hon. Secretary, 90, Bank Street, Clayton, Manchester, 11.

Welling and District Model and Experimental Engineering Society

Herewith is our forthcoming fixture list:

December 28th.—Informal meeting.

January 3rd, 1947.—Talk by Mr. Lambert.

January 11th.—"The Construction of 'O' Gauge Metal Coaches," Mr. Adamson.

January 17th.—Committee meeting.

January 25th.—Film show, including the film "New Hobbies."

January 29th.—Visit to Mount Pleasant Depot, Post Office Tube Railway.

Hon. Secretary: J. F. KING, 150, Sutherland Avenue, Welling, Kent.

South London Model Engineering Society

With the object of bringing together into closer unity all clubs in Surrey and Kent, a special meeting to devise ways and means will be held on Wednesday, January 15th, at Kings College Sports Ground, Dog Kennel Hill, East Dulwich, at 7.30 p.m.

Each club has been asked to send at least four delegates to present their Society's views and suggestions; there is no question of affiliation or fees, the main object being to formulate full co-operation, mutual help and encouragement as needed among the Surrey and Kentish clubs.

Hon. Secretary: W. R. COOK, 103, Engleheart Road, Catford, S.E.6.

The Bristol Society of Model and Experimental Engineers

Our meeting of December 5th was taken as a "Brains Trust," when problems and difficulties that model engineers have to overcome were discussed at some length.

We welcome anyone interested in model engineering to our meetings, which are held at St. Nicholas Parish Hall, Trinity Place, off Trinity Street, Old Market.

Hon. Secretary: C. C. LUCY, 28, Bibury Crescent, Henleaze, Bristol.

Stockport and District Society of Model Engineers

On Friday evening, December 9th, Mr. Whiston aroused great interest with his descriptions of work in the shops at Crewe, our railway enthusiasts being enthralled by accounts of building the "Princess Royal," the "Royal Scot," etc. Friday, January 3rd, will be devoted to Mr. Gerrard, for his talk on "Steam Turbines." All lone hands and other visitors in the

district are welcome to any of our meetings held in the Dyers and Bleachers Club, Tiviot Dale, Stockport. First and third Fridays in each month, at 8.0 p.m.

Hon. Secretary: E. TERRY, 17, South Parade, Bramhall Lane, Bramhall, Stockport. Phone: Bramhall 577.

Whitefield Model and Engineering Society

Our first annual general meeting was held on November 30th. Officers were re-elected *en bloc*, with the exception of the treasurer, who is leaving the district. Mr. Priestly was elected in his place.

After the business, Mr. Wadsworth gave a most interesting talk on "Arc Lamps." At the meeting to be held on January 10th, 1947, Mr. Robinson will give a talk on "Tool Making."

Hon. Secretary: A. STEVENSON, 2, Newlands Drive, Prestwich, Lancs.

Birmingham Society of Model Engineers

Future meetings, on Wednesdays, at the White Horse, Congreve Street, Birmingham, 7 p.m. will be:—

Jan. 1st, 1947: Auction sale of spare tools, lathes or $\frac{1}{8}$ -in. hexagon Whitworth bolts.

Jan. 15th: Film show. A collection of scenes by Messrs. Campbell and Mills. Come and see yourself on the screen. Ladies invited.

Jan. 29th: Open meeting.

Feb. 14th: Annual general meeting.

Feb. 26th: "Bits and pieces night." Any member may be challenged to give a five-minute talk on his own particular bit or piece.

March 12th: Talk by Mr. Addenbrooke, on "Foundry Practice."

Hon. Social Secretary: B. HUMPHREYS, 94, Beeches Drive, Erdington, Birmingham.

Bury, Radcliffe and District Model Engineering Club

We have been accepted as an affiliated club by the Northern Association of Model Engineers. We hold our meetings each week on Tuesday evening, at 7.30 p.m., the first Tuesday in each month being the official business meeting.

Our meetings are at our clubroom in the old Technical School, in Broad Street, Bury, where other modellers and members of other clubs will be welcomed.

Hon. Secretary: F. SHARP, 7, Mostyn Avenue, Bury.

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Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to THE SALES MANAGER, Percival Marshall and Co. Ltd., 23, Great Queen Street, London, W.C.2.

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Model Engineer's Workshop, including 4½" Britannia Lathe, with ½ h.p. motor, 230/1/50, countershaft, chucks, also large assortment small tools, castings, etc., £100.—POOLE, East View, Hawkhurst, Tel. 241.

Pint Spray Guns, £3 10s.; 3 cubic feet compressors, £8 10s.; air chambers with gauges, etc., £3. Illustrated lists.—H. HALL, 2, Glamis Way, Greenford, Middx.

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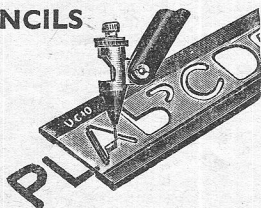
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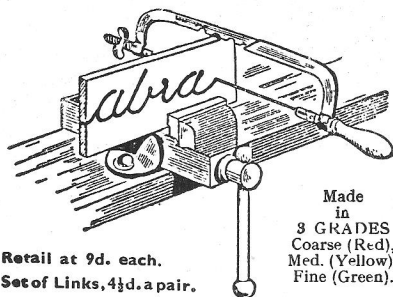
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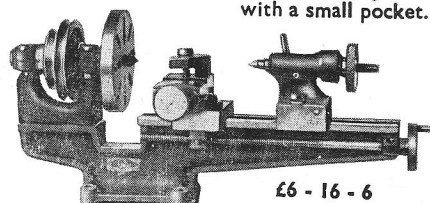
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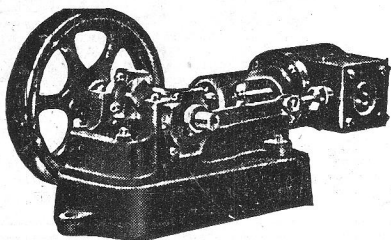
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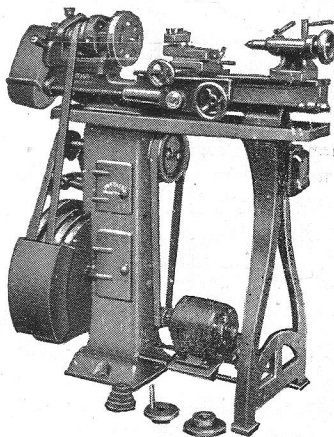
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